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TROLLEY TOURS.

An institution due to the modern development of the trolley system and only rendered possible within the last few years, is the trolley touring system. Trolley roads are permeating and traversing the country in so many directions, that a large network is being developed and it becomes possible to take comparatively long journeys, with both comfort and advantage. A very pleasant way of taking a vacation is to select a route that is followed by trolley cars as nearly continuously as possible and start with a hand bag, pausing here and there on the way for rest and refreshment or special objects of interest. The transportation charges average about one cent per mile, or less than one-half steam railway charges, while there is a complete absence of coal dust and smoke. Owing to the reduced speed of traveling, the country can also be more closely watched and remembered. The number of the party can also be from one to ten or more.

STORAGE BATTERY CARS.

Very much on the principle that the blood of the martyrs is the seed of the church, the present pronounced success and popularity of the storage battery in a wide range of electrical arts must be referred back to the days when the attempts to employ it for traction purposes on street railways all ended in failure of various degrees. Many lessons of great value were learned while making those efforts, and when with a spirit of resignation the battery manufacturers turned their attention to the use of the batteries in the power plants or for distinctive lighting work, they were probably very much surprised at their own immediate success. It cannot be said that the field of traction was wholly abandoned, for there was the remarkable trial on the Chicago & Englewood, with its fine records of endurance, efficiency and economy; but it is broadly true that effort and investment have of late neglected or condemned the battery for traction, letting the automobile apparently take up the problem just at the point where the car dropped it.

Still, even now, the battery "will not down" as appropriate apparatus for street railway work, and within a single week we have the news of the intention to resort to it again in New York City and in Washington. At the National Capital, the determination has already been reached to run ten cars of the Englewood type, and in this city the directors of a fair sized road have the use of storage battery cars in contemplation. It certainly cannot be inferred from such announcements that storage battery traction is a "lost cause" in the domain of electro-technics.

The reasons assigned for resort to batteries are interesting. In this city the line proposing to adopt them runs through a low-lying region near the water's edge, and it would appear that the overhead trolley is not permitted while the underground trolley conduit would always be in need of draining and often be deeply submerged. Hence an obvious preference for a system open to no such objections. In Washington, a leading reason seems to lie in the intention of one of the steam railroads crossed to elevate its tracks, seriously disturbing the route; so that the trolley would be awkward to handle and a conduit system would no sooner be laid crossing the Pennsylvania tracks

at grade than it would have to come up again. Here again is a valid excuse for the battery. And yet in neither case should the reasons assigned be referred to as excuses. It is no mean argument in favor of any appliance that it meets an exigency or an emergency that nothing else will adequately serve.

DAY POWER RATES.

The value of discussion at the meetings of electrical associations was well exemplified at the recent convention of the Canadian Electrical Association, an account of which appeared in our issue of last week. In fact, the papers read, interesting though they were, were in value secondary to the discussions they brought forth. In addition, suggestions as to topics for discussion contained in the Presidential address and in queries from the "Question Box" brought forth further valuable information from the members present. One of the most interesting discussions was on the subject of day power loads. The overlapping of power and lighting loads is a matter that assumes especial importance in the northern latitude of Canada, where in the winter time the lighting load comes on shortly after 4 o'clock in the afternoon. The solution to the difficulty thus presented has been found in making such rates for power during the day hours that manufacturers find it to their interest to close down their works before the lighting load comes on. From the discussion it would appear that where this solution has been offered not much difficulty has been experienced in securing its adoption. From the standpoint of the manufacturer, the lower cost of power and the decreased efficiency of labor after the lights are lit as well as the inferior quality of product, are inducements which have caused him to lend a willing ear to the proposition, while central station owners have found that they can profitably allow a discount that may be as high as ¼ and even ⅓ for power that is shut off before the hours of lighting load.

Both in the presidential address and in the discussion following the report of the Committee on Legislation, much satisfaction was expressed at the outcome of the efforts of the Association in obtaining legislative action protective of the central station industry. A bill passed since the last convention provides for the transfer upon fair conditions, of existing central station plants to municipalities when the latter decide to enter upon the business of supplying electricity. The most important clauses, however, are those which provide for arbitration, both in the case where there is failure of agreement as to prices for street lighting, and general complaint as to rates charged the general public. As was pointed out in the discussion, corporations dealing with the public are peculiarly subject to unfair claims and unjust demands, with the result of introducing a large element of hazard into the business of electric lighting. As a consequence of the ensuing instability, not only the interests of the capitalist but also those of the public are unfavorably affected, the feeling of insecurity engendered naturally leading to an endeavor to obtain larger returns on the capital invested than would be the case did the business rest on a perfectly secure basis. The legislation thus referred to is therefore to be much commended, since it not only protects the interests of the central station owner, but also benefits the users of electric light through the lower rates that naturally follow. The subject is one which might well be made a matter of study by our state electric light associations, with a view to securing similar action from their state legislatures.

AUTOMOBILES FOR THE MILLION.

It has been generally supposed by the public that automobiles were for the rich only, and the response to an inquiry as to the price is generally received with a deep sigh as though some fond hope were being relinquished. But there are many indications which go to show that the automobile of the future—and the very near future, at that—is to be within everybody's reach. Details are given in our columns this week as to the placing by one concern of an order for no fewer than 4200 electric vehicles of all types, representing an investment of about $8,000,000. If these were all going at once to wealthy people, it would involve what would be even for them an enormous expenditure. But as a matter of fact a great many of these vehicles will be of the ply-for-hire type, and as for the rest of them the policy and intention is to lease them rather than to sell them. It is a democratic plan, full of revolutionary possibilities in vehicular traffic, that is thus outlined, and as will be seen, it means at once, automobiles for the million. He will indeed be a poor man who cannot afford to ride in one for business purposes on week days or for an airing in the park on Sundays.

As to the plan of not selling the automobiles, the wisdom of that must be at this juncture largely a matter of opinion. It evinces a fine courage and a splendid confidence in coming events to justify it. To tie up eight millions in apparatus of speedy deterioration, in an art still young, and when it is very likely that two years will see radical changes in the very style and name of the vehicles we now ride in, is magnificent and it may still prove to be finance of a high order. But bicycles and sewing machines and typewriters and pianos and plows are sold outright, or sometimes paid for on instalment, and it is hard to believe that there would have been the rapid development seen in all of them if the original makers and patentees had decided to carry all the original stock of them until worn out by use. If the original parent lighting companies had only leased their dynamos and lamps, it is incredible that such swift strides toward perfection would have been made in electrical illumination. On the other hand, it may be fairly urged that the automobile is a machine, that the features of repair and charging necessitate skill and experience, and that patrons will be glad to be relieved of the initial outlay and of the continued worry of maintenance. This is true and pertinent, but there may be the reply that every week sees a nearer approach to the simplicity when anybody can "fool with the thing," and neither hurt it nor be hurt.

Perhaps the closest parallel to such a colossal system of leasing may be found in the Bell telephone, but the apparatus there placed in the hands of the customer is of very slight cost with a very low depreciation, and the amount of money involved in each individual case is very small. We are inclined to believe that a great many persons possessing the means will prefer to buy their automobiles outright and to treat themselves to the "model of 1900" or 1905 as each year comes around, charging them also at their own plants. But for a bold, definite scheme of opening up the use of the automobile to all, supplying the vehicles from one central organization to a number of sub, local or territorial organizations, the plan outlined above as that which we understand is being adopted by the company ordering these 4200 automobiles, has many merits, and it may in time vindicate itself by its fruits.

WATER WHEEL REGULATION.

The analysis of the effects of the inertia of a water column upon the regulation of water wheels, given in the paper recently presented by Mr. Allan V. Garratt before the American Institute of Electrical Engineers, suggests several considerations not touched upon by the author. One of these is the way in which the efficiency of the wheels or turbine at part gate affects the regulation. If the efficiency of a wheel rapidly runs down as the load falls off, the flow of water will not vary as widely under load fluctuations as though the wheel maintained a high efficiency at any and all loads. For instance, if a wheel uses half as much water again per horse-power-hour output at half load as it does at full load, a change from full load to half load means

only a 25 per cent. reduction of the flow instead of 50 per cent., which would occur were there uniform economy at all gate openings. The result in case of poor economy at part load would be a reduced gate movement and correspondingly reduced acceleration or retardation of the column of water feeding the wheel, which in case of a long, closed flume would greatly aid the governing.

The ideal condition in this respect is reached in those wheels of the impulse type in which regulation is obtained by means of deflecting nozzles or hoods, the full flow of water being maintained whatever the load upon the wheel may be. In this case there is no inertia interference, no matter how long the closed pipe line may be. In many instances as, for example, that of Niagara, water wheels utilize only a part of the total flow, and economy of water—especially at part gate—is not considered. When turbines are used under such conditions, the bad effect of the inertia of the water column can be overcome by arranging a bypass to be operated by the governor, so that as the flow through the wheel falls off the flow through the bypass increases to make the total flow constant.

On account of this peculiar effect of the efficiency of the wheel, those turbines having a large water consumption at part gate are often to be preferred, and it frequently becomes advisable to specially design the wheel or governing devices to give this property. A simple method of doing so is to throttle or check the flow of water some distance back of the orifice to the buckets instead of as close thereto as is possible, which is common practice, and proper practice where economy at all gates is desired. In case of impulse wheels with nozzles, instead of varying the number or changing the area of the latter, the flow of water should be controlled by gates some distance back in the supply piping, so that the velocity at the nozzle will fall off at part load, reducing thereby the efficiency of the wheel. In case of turbines, the governor should be made to work gates anywhere back in the flume except cylindrical or register gates in close contiguity to the runner.

Another influence is that of the cross-section of the pipe line in the case of a closed flume. The larger this is, the less will be the velocity of the water within it, the less the amount of energy absorbed or given out by a given change of flow and the less the variations of the head upon the wheel, due to the inertia. By one of the simplest laws of mechanics, the inertia of any moving body is proportional to the product of its mass and the square of its velocity. If the cross-section of any closed flume is doubled, the mass of water contained therein is doubled, and the velocity for a given load is cut in two. The amount of stored energy is doubled owing to the increased mass, and divided by 4 by reason of the diminished velocity, and is therefore half that with the smaller flume. The amount of energy absorbed or given out by any change of flow upon change of load is similarly reduced by increasing the cross-section of the flume.

ELECTRICAL ENERGY DIRECTLY FROM CARBON.

An interesting paper by Mr. Case, recently read before the Royal Society is printed in this number. It describes a voltaic cell in which electrical energy is produced from the consumption of carbon. The simplest form of the cell consists of a carbon-platinum couple immersed in an aqueous solution of trichloride of iron. The theory of the cell is that the carbon reduces the trichloride to the dichloride, and in doing so forms carbonic dioxide and hydrochloride. If the cell were hermetically sealed, the action would cease as soon as all the trichloride solution had been reduced to the ferrous or dichloride state. But by the well known action of the oxygen in air upon dichloride of iron in an aqueous solution of hydrochloride, the salt is rechloridized to the trichloride. According to the thermo-chemical theory of the cell, its maximum e. m. f. should be slightly less than half a volt, and e. m. fs. up to a quarter of a volt are stated to have been obtained. From a theoretical standpoint, such a cell has great interest, seeing that it is self-regenerating and consumes nothing but carbon, the negative or platinum electrode remaining, of course, unaltered. So long as the cell works, there is a steady dechlorinization of the solution at the positive or carbon plate, with the development of carbonic acid, and a steady automatic rechlorinization through the influence of the atmospheric air. Such a cell has many theoretical advantages. From a practical standpoint, the cell as described would have no commercial value, not only because its e. m. f. is very low, but also because of the polarization described and attributed to the carbonic acid generated. In addition to this, the regeneration of the cell by the oxygen of the air is a slow and diffusive process. According to the experimental results described, it is also likely that there would be local action during the inaction of the cell.

The author of the paper, however, has evidently aimed at the development of the principle of the cell, and not at the development of the cell as an article of manufacture and use. The principle is a most hopeful one. Any piece of carbon contains, in conjunction with the oxygen of the surrounding air, enough potential energy to lift it about two thousand miles against the force of gravity at sea level, or, otherwise stated, to propel it from New York to Panama against a force equal to its own weight. We are content, at present, to obtain at most 15 per cent. of this energy, by burning the coal under a steam engine boiler, allowing 85 per cent. to escape in heat, which inefficiency follows from the inexorable operation of the second law of thermodynamics. On the other hand, processes conducted by other than thermal means are susceptible of a much higher efficiency. The ordinary working animal, human or equine, is considered to have a net efficiency of over 20 per cent., reckoned from the useful energy output to the theoretical chemical energy value of the food. If the same animal were a heat engine instead of a chemical engine working between 35° C. and 20° C., its maximum possible efficiency would be less than 5 per cent. Consequently, if an animal as a chemical engine is already much more efficient than a heat engine working between the same temperatures, it is only reasonable to expect that some specially devised electrochemical engine should be capable of giving us cheaper power efficiently. Even though it be a fact that the best zinc-consuming voltaic cells to-day are hopelessly unable to produce power on a large scale in competition with the steam engine, Mr. Case's paper indicates that the principle of electricity from carbon is not only logically, but also experimentally sound, and we await the discovery of the specific means which shall be effective and economical. Coke is cheap and atmospheric air is bountifully gratis, but what is to be the intervening connecting mechanism? Another theoretically interesting combination described in Mr. Case's paper, consists of a cell in which the two plates are of the same substance, and these dip in an aqueous solution of ferrous chloride. By the symmetry of the arrangement it is evident that no e. m. f. could be produced, but on blowing oxygen through the solution surrounding one plate, an e. m. f. is produced.

A clear and widespread appreciation of the existing limitations of the voltaic cell as an energy producer, would save the community much money every year. Claims are constantly being made by inventors for the superior merits of their new voltaic combinations over engines and dynamos. The law of conservation of energy does not, of course, interfere with any such claim, because the question is entirely one of cost. What is needed is a general recognition of the fact, fully understood by those versed in the science, that a cell which consumes zinc cannot compete commercially with a boiler which consumes coal, so long as zinc requires to be produced by the operation of coal-consuming furnaces.

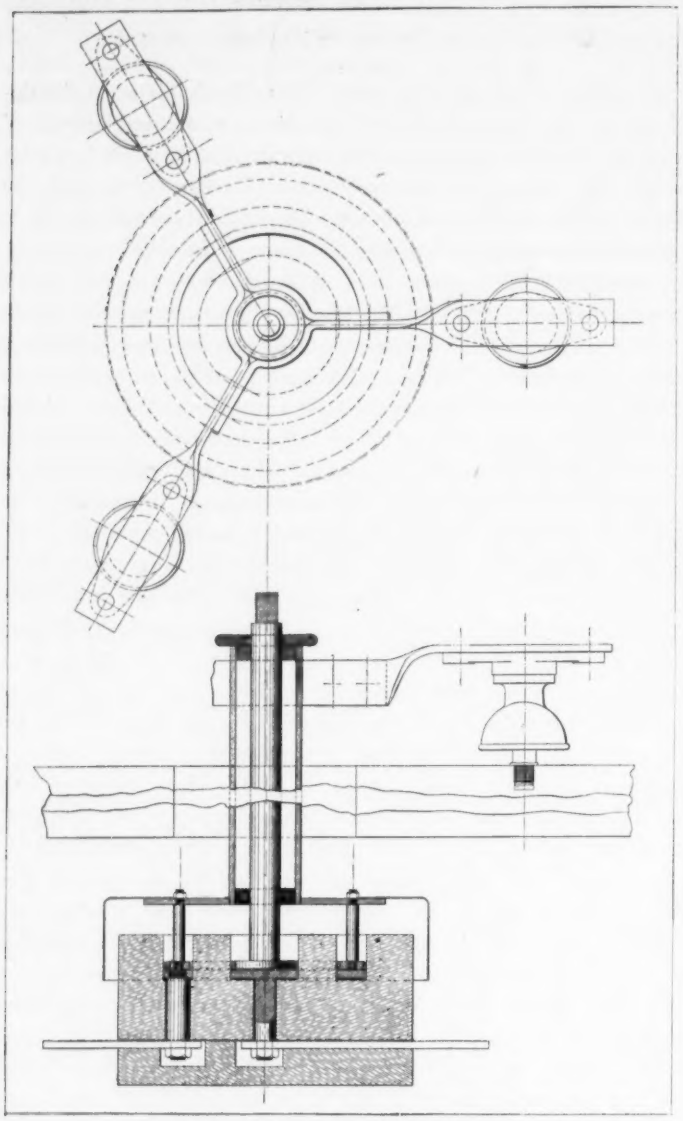
Electric Contact Device for a Drawbridge.

BY E. T. BIRDSALL, M. E.

The accompanying illustration shows a contact device designed by the writer and now in use on the drawbridge over the Harlem River at Third Avenue, New York City.

This bridge, the draw of which is one of the largest in the world, is lighted by enclosed arc lamps operated from an engine and dynamo on the draw, the current of about 400 amperes being conveyed to the approaches by means of armored gutta percha cables connected to the contact device. A flexible cable was out of the question, as the draw occasionally makes several revolutions in one direction, before reversing. This device has been in satisfactory operation for about a year and is not patented. The same device will be used on the bridge now being built over the Harlem River connecting Willis Avenue with First Avenue.

The centre contact plate is 2" in diameter and the outer contact



PLAN AND SECTION OF CONTACT DEVICE.

ring is ¾" wide, and the inner hole 5" diameter. The thickness of the mercury film is not over 1-16". The device is placed at the axis of the draw and the marble cup is not rigidly connected to the support. It is attached to the ring which carries the inner ends of the axles of the wheels upon which the draw span rests and turns. This arrangement is of proved efficiency, and, as far as is known, of novel design, being free from the defects common to the ordinary form of rubbing contacts now used on drawbridges.

The device consists of a marble block, shown in section, in which are turned two cavities, one a circular central opening and the other a circular groove concentric with the central cup. In the centre opening is placed a copper disc and connecting lug as shown partly in section; in the annular recess is placed a copper ring to which a lug is attached. This ring and centre disc with their lugs are bedded in "Edison compound" in the marble block. The terminals attached to the lugs are protected by a second block of marble, having proper recesses, cemented to the upper block with similar compound. The upper or movable part consists of a copper rod carrying a disc on the lower end, surrounded by an insulated copper tube carrying a ring, and the thin brass dust shield as shown. The upper ring and disc are adjusted to within 1-16 inch of the lower ones and enough mercury poured in to fill the cups nearly to the top of the upper ring.

It will be noticed that the lower part of the device is not fastened to the bridge structure, but is free to move to accommodate itself to any eccentricity of the draw, being connected to the junction boxes by flexible cables. The upper part is adjustably secured to the draw by means of "Barn" type of trolley hangers which give the necessary insulation and strength.

The Detroit Railway Situation.

A despatch from Detroit referring to the municipal street railway imbroglio says: The city is in a furor over the present situation. All the newspapers and nearly all the leading citizens are opposing the Pingree plan, and it is now claimed that the majority of citizens oppose it, on the ground that three-cent fares and quasi-municipal ownership will fail to pay the expenses and the $17,000,000 proposed to be paid for the roads, and that they will, if purchased, revert to the present owners. In the latter event, the roads would be operated under the security ordinance already passed by the council, which permits the operation of all the roads at six-for-a-quarter fares for from thirty to forty-eight years. The Pingree people claim that the roads will certainly pay off their purchase price under three-cent fares. Gov. Pingree is having circulars distributed on the streets giving his side of the controversy.

As we go to press, a despatch of July 18 from Detroit says: Municipal ownership of Detroit's street railways under the plan lately agitated was given what is believed to be a final quietus by the Common Council to-night. A reconsideration of the "security" ordinance was ordered by an unanimous viva voce vote of the Aldermen. Then further consideration of the ordinance was indefinitely postponed. This is the franchise which was passed at the last Council meeting under very exciting circumstances, President Beamer charging that some of the Aldermen who voted for it were improperly influenced in its favor. The "security" franchise was designed and asked for as security for the bonds with which the Detroit Municipal Railway Company purposed purchasing the railways from their present owners. It provides for six-for-a-quarter fares practically for forty years. The so-called "working ordinance" under which the Detroit Municipal Railway Company proposed to operate was also indefinitely laid on the table to-day by the committee which had it under consideration.

Copper Production Increase.

The report on the production of copper in 1898 submitted to the U. S. Geological Survey by Special Agent Kirchoff, shows the production of the United States in that year was 526,373,591 pounds, which is by far the largest product ever reported. This report shows that 1898 was one of general prosperity for the copper mining industry, the full product being marketed at prices slightly better than those of 1897. The actual capacity of copper, with its accompanying upward rush in price, and its enormous expansion of stock speculation, did not in reality develop until the end of the year. It did not tell upon the returns for the year 1898. The increase in the production of copper was largest in Arizona, while the lake district also recorded an advance.

Marconi Experiments.

A second series of experiments for the French government were commenced by Signor Guglielmo Marconi on June 15, messages being sent from the Vienne, a French transport, to land stations up to a distance of 42 miles. The mast of the cruiser has a height of only 90 feet. Wimereux, near Boulogne, and the South Foreland Lighthouse on the Kentish coast, were used as the land stations. The greatest distance appeared to have no effect, the messages, it is stated, being recorded at the receiving station at the South Foreland with unvarying distinctness. Messages were exchanged while the vessel was traveling at various conditions of speed, with the same result. An interesting feature in the experiments was stated to be the facilities with which Mr. Marconi's latest development for cutting out a station was applied.

Canadian Water Power Electrical Plants—IV.

THE OTTAWA ELECTRIC COMPANY, OTTAWA, CANADA.

By E. M. Archibald.

THE Ottawa River, its source far back in the mountainous and lake country on the northern shores of Lake Superior affording an unfailing water supply, flows in a southeasterly direction. It furnishes natural boundary between the provinces of Quebec and Ontario, passing Ottawa, the Canadian capital, on the Ontario side, and the City of Hull directly opposite, till it reaches and swells the mighty tide of the St. Lawrence.

Directly at the city the river narrows and pours in an immense torrent over an irregular rocky ledge, falling a distance of thirty feet—the Chaudiere Falls (Fig. 1). These falls have long been used for industrial purposes, mostly pulp and sawmills; on the Quebec side are situated Eddy's famous mills, the largest in Canada, for manufacturing matches, pulp and paper.

To obtain a greater head and economize water a wooden dam was long ago constructed across the river above the falls and is still used. There are several small islands in the river channel below the falls, but to such an extent have they been built upon by mills that scarcely a semblance of an island is discernible. This is known as the power district, and may be seen in the illustration at the head of this article. Immense wooden flumes supply these mills with water, where after being converted into power it falls to waste in the tail race beyond, which is just the continuance of the river.

Many years ago when the lumbering industry was started and people wanted the water power for their sawmills, the Government took hold and let it out in sections, each man getting a certain number of water lots, as they are called, for which he must pay a certain rental. This remains his so long as he continues paying his rents and using the power. Such being the circumstances, it is now exceedingly difficult to obtain any water power, as it is all taken up and those willing to dispose ask a very high price.

In 1886 an incandescent light company was organized, a plant erected using water power, and shortly after a direct-current power service was added. Previously, however, a separate company had received the city contract for lighting the streets by arc lamps and they were in operation using water power for that service alone. Not content with two companies being already in the field, a third started a separate plant, selling incandescent lighting and power. After the usual competition that must inevitably result, at length all were amalgamated, becoming the present Ottawa Electric Company.

Here they were, situated with three stations on their hands and no means either of placing all the apparatus in one station or even extending any of those already existing. The arrangement arrived at and still used is to run the arc station separate, but to transmit the current generated in the smaller stations to the larger and thence distribute it through the city.

Business increased rapidly, in fact almost too rapidly, and as there was no way of increasing either of their present stations, another water lot was obtained and a small station erected to develop all the water power available at that place.

Then trouble began to be experienced with frazil and anchor ice, as no provision had been previously made for its disposal, and a steam plant was erected to be used only as an auxiliary. Still business increased until at present there are five separate water power stations and one steam plant, their respective positions being shown on a map of the power district. Even now, during the period of heavy loads in winter, the steam plant has to be brought into requisition. Such are the conditions in Ottawa, making the plant there a most unique one.

The main station, No. 1, as it is called, is a two-story limestone structure, the foundation resting on the bed rock at the bottom of the river. The head race here is about 500 yards long by 40 feet wide by 10 feet deep, the water entering the wheel pits perpendicular to the direction of flow through wooden racks to prevent rubbish from following. A wooden boom some distance from the racks is also used to keep ice and drift wood away from the wheels. No serious trouble has ever been experienced at this station with either frazil or anchor ice, as the overflow current sweeps it all away.

The wheels are five in number, each developing 500-hp at 80 r. p. m. under the average head of 22 feet obtained here. They are of the new American type, are vertical, connected each to a separate shaft by means of heavy mortise bevel gearing, upon which is placed a 10-foot pulley belt connected to a long line of countershafting on the ground floor. One wheel, however, is directly belt-connected to an alternator situated in the dynamo room above.

All regulation is performed by hand by turning a wheel geared to the cylinder gates raising or lowering them and thus allowing more or less water to enter the wheel chamber.

From pulleys on the countershaft connected by Hill friction clutches, the dynamos on the floor above are belted. The speed of the countershaft is 300 r. p. m.

On the upper floor is situated all the electrical apparatus, with the exception of one generator which, however, is included in the list consisting of one 250-kw and five 100-kw, single-phase alternators, generating current at 16,000 alternations per minute or at 133 cycles per second, and at a pressure of 1200 volts, manufactured and installed by the Royal Electric Company, of Montreal, Canada, with their various exciters, one for each machine belt connected to the countershaft. Of the six exciters, three are 10-kw bipolar Royal Electric and the remainder a 4-kw, 5-kw and 6-kw arc Westinghouse machines. Should an exciter break down, another is put into circuit by throwing over a double-pole, double-throw switch on the machine panel on the switchboard. This completes the lighting apparatus in this station.

For power purposes there are two services, both of which are direct current, one at 250 and the other at 500 volts. The equipment for this consists of one 180-kw 500-volt 4-pole Westinghouse generator, and four 60-kw 250-volt Royal Electric generators, all compounded.

Should the load on the 500-volt service be too great for its one machine, or should it become stalled, two of the 250-volt machines can be coupled in series at the switchboard. At present the voltage on the power circuits varies greatly, due to the variation of load, but a storage battery plant of 250 cells type "L_9" from the Electric Storage Battery Company, of Philadelphia, is being installed at the end of the feeder as a regulator to steady the voltage and as such will be alternately charging and discharging, producing a steady load on the generators. Their discharge rate will be 80 amperes for four and one-half hours, but they will temporarily discharge at 160 amperes.

The switchboard, a portion of which is shown in Fig. 2, is in three parts, the first consisting of six panels for the Royal Electric Company's machines; the second being the main board to which the terminals from the machines in the substations are connected, and which is also the distribution board; and lastly, the power board consisting of five panels.

The middle portion, to which all Westinghouse machines are connected, is similar to the Westinghouse switchboard used at the World's Fair in Chicago, consisting of the plugging apparatus for connecting the various circuits to certain machines, potential indicator and ammeter of the Westinghouse pendulum type, a compensator in each circuit to read the voltage at the centre of distribution, and a Stillwell regulator in each feeder directly in front of the switchboard to raise or lower the voltage by cutting in or out secondary coils of a transformer in series with the line, the primary coil being in multiple with the same. In this way the voltage is boosted up to any degree desired.

On the first portion of the switchboard, that is, the part seen on the left of Fig. 2, are situated the instruments of the T.-H. type, the exciter and field switches and rheostats, all for the Royal Electric alternators. The alternators are not coupled in parallel, but are operated singly, the load being divided at the main switchboard in proportion to the size of the machine as nearly as possible.

FIG. 1.—CHAUDIERE FALLS.

In each feeder is placed an aluminum fuse in a lignum vitæ box, the terminals being air tight so that should the fuse blow, it will do so in the middle and thinnest part, from which the gases can escape to the atmosphere through an opening cut in the cover.

Taps are taken off each feeder to a lightning arrester of the Wurts non-arcing short-gap type, having six gaps between each line and ground. Two No. 0000 copper wires connect each generator in each substation to the switchboard in this central station.

A simple system of signaling by means of gongs in connection with the private telephone line connecting each station, has been established to enable the switchboard attendant to order the voltage raised or lowered on any particular machine.

The power switchboard, consisting of five marble panels, is at the extreme right. Ammeters of the edgewise type are used, this being perhaps the only distinctive feature. Connections may be made on the face of the board to couple two 250-volt generators in series to aid the 500-volt circuit, and should this not suffice, a line is run to the Street Railway power house and current from their 500-volt line used. Lightning arresters protect every power line, and are situated at the entrance of each line to the building.

ARC STATION.

The arc station, or No. 2, as it is called, is likewise a two-story stone building. A head of 20 feet is obtainable here, the water being taken from an immense wooden flume supplying many mills, of which this is only one.

From the six vertical water wheels power is transmitted to jack shafts by heavy mortise bevel gearing, and then to a long line of countershafting by rope drives. To pulleys on their counter-shaft the arc machines, situated on the floor above, are belted, a method of starting and stopping any one, independent of any other machine being afforded by using friction couplings.

In this section there are no less than twenty-six arc machines, of various sizes and types, as follows: One 125-light Brush multi-circuit machine, headboard and regulator attached; one 65-light Westinghouse machine, with a 1-kw dynamo for field excitation, regulation being performed wholly by armature reaction; three 65-light Brush machines; one 50-light T.-H. machine; three 40-light T.-H. machines; six 35-light T.-H. machines; seven 25-light T.-H. machines; and one 12-light T.-H. machine. A number of the smaller machines are coupled two in series, while the largest machine is divided into two circuits, thus making an average of from fifty-five to sixty lights on each circuit.

The old style wooden board is being replaced by a handsome five-panel white Italian marble board, manufactured by the Western Electric Company. The frame is of angle iron and the board consequently is fireproof. There are connections for twenty-four dynamos and twenty-four circuits, although extensions may be made at either end. An ammeter and polarity indicator are placed in each circuit, while situated in the center of the board is a ground detector.

In this station as in all others owned by the Ottawa Electric Company, fire hose is conveniently situated on an automatic reel, such that the act of unrolling the hose operates a valve by means of gearing and turns the water on. An ordinary valve is also connected.

STEAM AUXILIARY.

The steam station, No. 3, is a one-story brick structure in the power district near the other stations. This was constructed wholly with the idea of being an auxiliary plant to aid the other stations when trouble occurred with ice to hinder their operation, but so rapidly has business increased that in winter this plant has to be used to some extent to assist in carrying the load normally. The position of the chimney is in a central location and is most favorably situated for any extensions to be made and is of such a size as will admit of doubling the present capacity.

The steam equipment consists of six 200-hp water-tube boilers manufactured and installed by the Goldie & McCulloch Company, of Galt, Ontario; two Northey feed pumps for the boilers, water for which is obtained outside the door from a small discharge into the Ottawa river; two 600-hp tandem compound condensing engines of the Jerome Wheelock system, built by the Goldie & McCulloch Company. The jet condensers which are used in connection with these are situated in an open space under the power house floor. These engines operate at 85 r. p. m., power being belt-transmitted to a counter-shaft running at 300 r. p. m. The pulley on the counter-shaft thus belted runs on a hollow sleeve connected to the counter-shaft by a friction coupling, by which means power may be thrown on or off.

The electrical equipment consists of two 240-kw Westinghouse single-phase alternators generating current at 1200 volts and at a frequency of 16,000 alternations per minute, or 133 cycles per second: and one 120-kw Westinghouse alternator of the same type. Each machine has a separate exciter belted to the counter-shaft,

two of 5-kw capacity, and the other of 4-kw, all Westinghouse machines.

There is also a 500-kw 4-pole 500-volt Westinghouse railway generator, having just been removed from the Ottawa Electric Railway Company's power house, and which may be driven here should any accidents occur while installing a new equipment. This is also belted to the counter-shaft.

The switchboard in this station consists of three marble panels and contains the ordinary instruments, switches, rheostats with Wurt's lighting arresters situated at the top of the board.

Of the remaining three power houses there is not much worth mentioning except that the electrical apparatus consists of alternators of the following number and size:

One of 420-kw of the small-toothed armature type for producing better regulation than the ordinary large-toothed armature, and two of 240-kw capacity each, all 1200-volt Westinghouse single phase machines having a frequency of 133 cycles per second; three exciters, each 10-kw bipolar machines, manufactured by the Royal Electric Company, of Montreal.

Besides these there is a 60-kw single-phase alternator running at 2000 volts, with its T-H exciter, belonging to the electric railway

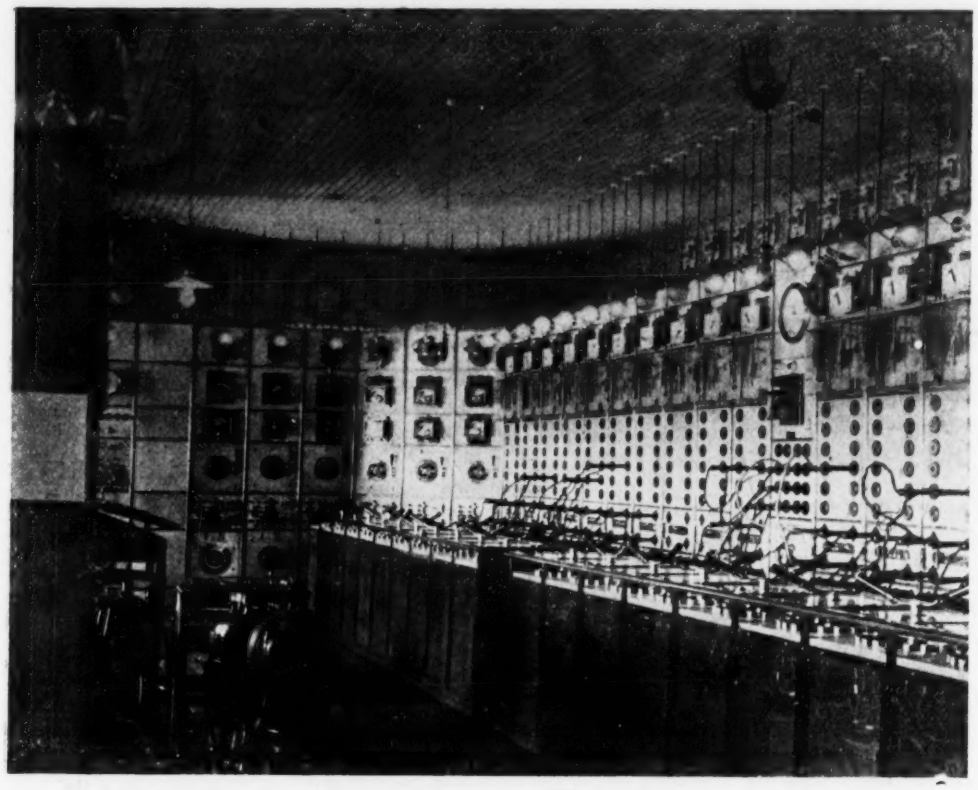


FIG. 2.—PART OF THE SWITCHBOARD.

company, and used for lightning an amusement park managed by it, situated three miles from the city.

In station No. 4 a bank of transformers is placed, consisting of six 25-kw, Royal Electric, and two 20-kw Canadian General Electric transformers in multiple, reducing to 100 volts—that required for a small calcium carbide factory which has commenced operations.

The feeders at 1200 volts run all over the city, the pressure being reduced for house lighting to either 50 or 100 by the use of Packard transformers, the large sizes being used wherever possible.

Current is sold almost exclusively by meter, 69,000, 16-cp, 3.5-watt lamps being thus supplied. 4000 lights are supplied to light the Parliament buildings on a special contract; the remaining 4000 lights are supplied by the flat rate, making in all 77,000 lights for a population of 60,000.

The meter rate is one cent per ampere hour for 50-volt lamps, or two cents for 100-volt lamps; a discount of 40 per cent. is allowed off this for prompt payment, thus reducing the rate to six cents per ampere hour. For flat rate customers $6 per light per year is charged.

The power service is small, only some 500-hp being installed and all in small sizes, mostly for elevator work, ranging from 1 to 20-hp. Power is sold both by meter and by flat rate, the former varying from ten to five cents per kw hour, according to the service required, and the latter ranging from $90 to $30 per hp per year.

In the arc light service 675 lamps of 2000-cp are supplied, of which 400 are for the street lighting, the remainder being commercial lamps.

Summing up, the amount of electrical energy capable of being produced at the various stations owned by the Ottawa Electric Company, is 2250-kw for incandescent lighting, 420-kw in direct current for power and arc machines for supplying current to 952 2000-cp arc lamps.

In concluding, the writer wishes to express his indebtedness to Mr. A. A. Dion, general superintendent, and to Mr. John Murphy, superintendent of stations, for the willingness and readiness with which all information has been given and for other courtesies received.

A New Marconi Patent.

A United States patent was granted June 27 to Signor Guglielmo Marconi on a new form of wireless telegraphy receiver circuit. A previous patent was on a receiver of which one end of the coherer was connected to earth and the other to an insulated aerial conductor. In the present patent the earth connection is made through the primary of induction coil, the coherer being in the secondary thereof together with a condenser. According to the illustration, the coherer is in parallel with two circuits; one circuit contains the usual receiver devices, and the other a condenser and the secondary of an induction coil, the primary of which forms part of the earthed aerial conductor, which latter is not insulated. It is stated to be desirable that the induction coil should be in tune or syntony with the electrical oscillation transmitted, the most appropriate number of turns and most appropriate thickness of wire varying with the length of wave of the oscillation transmitted. The condenser capacity should be varied if the wave is varied. It is desirable that the aerial conductor should offer a large surface, and therefore the use of broad wire netting instead of wire is desirable. It is stated that the introduction of the coil in the circuit not only improves the signals, but also prevents to a great extent any interference due to atmospheric influences, since any atmospheric electricity collected by the aerial conductor escapes to earth through the primary of the coil, thus preventing a charge from accumulating and discharging through the coherer. It is also stated that any stray interference can be further minimized by substituting a suitable capacity for the earth. Good results have been obtained with an induction coil having a primary wound on a glass tube .635-cm in diameter and consisting of two parallel windings of 200 turns each of single silk-covered No. 36 copper wire, the resistance being 3.1 ohms in parallel. The secondary consisted of about 800 turns of a similar wire smaller than No. 40 (.005-cm), wound over or under the primary, the resistance being about 140 ohms. The condenser preferably used is composed of 12 tinfoil plates, each 2 inches by 1¼ inches, and insulated by paraffined paper 6.8 mils thick. The aerial conductor in some cases consisted of a plain stranded copper wire, and in others of a galvanized iron netting two feet broad.

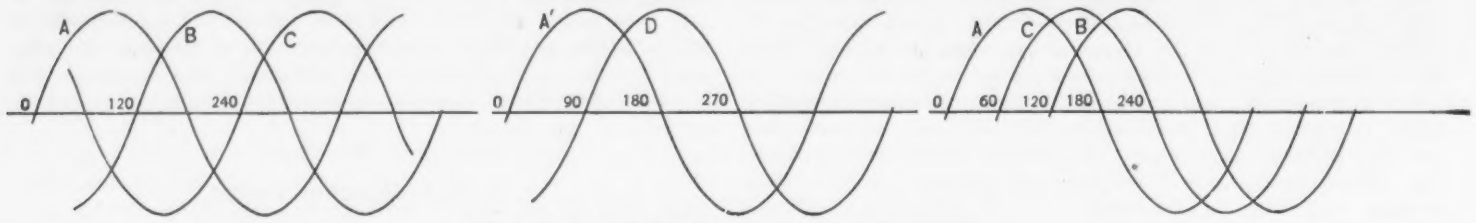
Electric Plant at Matanzas, Cuba.

A press despatch from Racine, Wis., is to the effect that Mathew Slush, A. W. Bishop and other officers of the Milwaukee, Racine & Kenosha Electric Railway Company, have an option for six months on $750,000 worth of land at Matanzas, Cuba, upon which, if it is purchased by them, will be erected a large electric lighting plant and a large warehouse, while a system of electric railways will be built from Matanzas to the neighboring towns.

Transformation of Three-Phase to Two-Phase Currents.

By P. G. WATMOUGH.

Perhaps it is safe to say that the majority of electricians have a very misty conception of the manner in which transformers change three-phase to two-phase currents, and vice versa. The following explanation, apparently not given in any of the standard text books, may place the matter in a clearer light. Starting with the assumption that three-phase currents are to be changed to two-phase, the former relation being represented in Fig. 1; then the problem is to combine the curves A, B and C in such a manner that there will result two curves of equal magnitude and having 90 degrees difference in phase, this being the two-phase relation and represented in Fig. 2. By taking Fig. 1 and reversing curve C the result will appear as in Fig. 3. It may be remarked that the curves now have a displacement of 60 degrees relative to each other. If we lay off curves B and C with their maximum ordinates proportional to 100 and increase the value of A to 173, we may plot a new set of curves, as shown at the left hand side of Fig. 4. Combining curves B and C by adding their ordinates (see right hand side of Fig. 4) produces a fourth curve marked D, which is seen to be equal to curve A' and lagging 90 degrees behind it.



FIGS. 1 TO 3.—TWO-PHASE AND THREE-PHASE CURVES.

In other words, curves A' and D represent the two-phase relation, produced by curves A', B and C; these three latter being obtained by slightly modifying the original three-phase curves.

FIG. 4.—COMBINED CURVES.

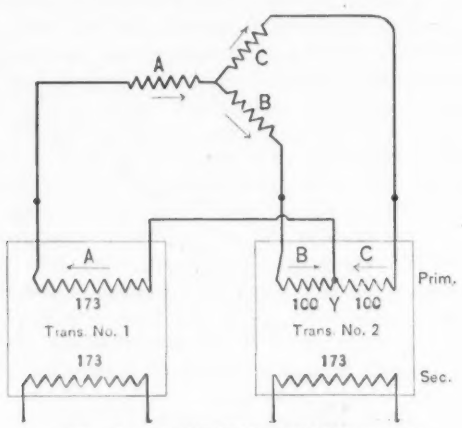
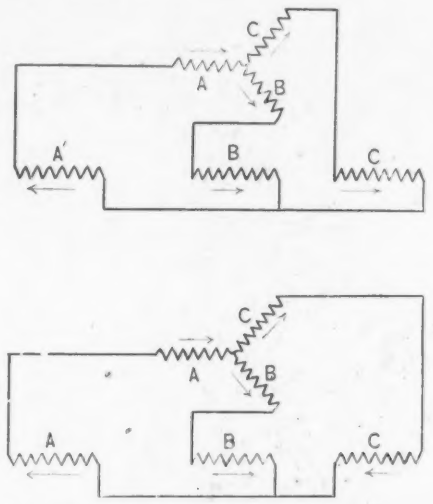


FIG. 5.—TRANSFORMER CONNECTIONS.

We may consider the curves in Fig. 4 as representing values of magnetic flux produced in two transformers, the flux in transformer No. 1 being represented by curve A'. Curve D represents flux in transformer No. 2, due to the resultant of fluxes B and C. The fluxes A' and D being of equal value and 90 degrees apart, it is obvious that the e. m. fs. generated by them in the secondary coils will bear the same relation to each other, and hence produce two-phase currents.

In order to arrive at the above results in practical operation, electrical connections should be made as in Fig. 5, which represents two transformers with their primaries joined to a three-phase alternator, the secondaries being open-circuited. The figures represent the proportion in which the coils should be wound for a 1.73 to 1 ratio. It will be seen that the current flowing in coil A (corresponding to curve A', Fig. 4) energizes transformer No. 1, and that the current flowing in coils B and C combined (coil C being reversed) energize transformer No. 2. In order to show that coil C is reversed, Fig. 6 is drawn representing the alternator joined to three coils connected in a straight Y. Fig. 7 is the same connection, with the exception of coil C, which is reversed. By tracing out it may be seen that this last connection is identical with the connections shown in Fig. 5. The arrows indicate only polarity of current.

The clock diagram affords a very concise way of representing the



FIGS. 6 AND 7.—ALTERNATOR CONNECTIONS.

results which we have just arrived at.

In Fig. 8, A, B and C represent the values and phase relation of the currents as derived from the three-phase alternator. Fig. 9 shows effect of reversing coil C, the three-phase currents now being 60 degrees apart.

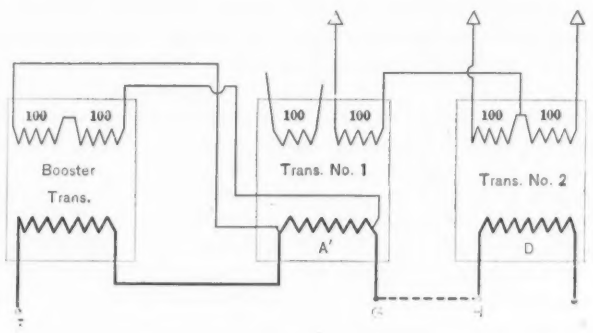


FIG. 12.—TRANSFORMER CONNECTIONS.

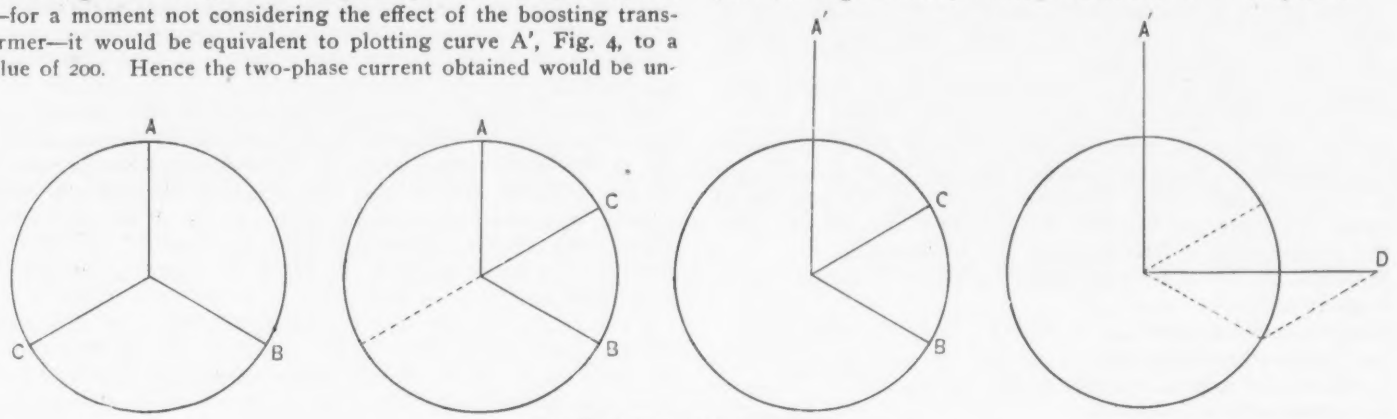
Fig. 10 we must conceive as representing the magnetizing forces produced in two transformers by a three-phase current passing through the primary coils. B and C are taken as proportional to 1, and value of A has been increased to 1.73 by winding more turns on coil A. A' represents the flux in one transformer. B and C

acting together in the other transformer produce the resultant D, shown in Fig. 11, which may be geometrically proved to be equal to and at right angles with A', hence fulfilling two-phase conditions.

It is possible to accomplish the transformation with three ordinary transformers, provided that the primaries have two coils so that connection can be made in the middle of the right hand transformer. It was shown above that for every 100 turns in each primary coil of transformer No. 2, there should be 173 turns in transformer No. 1, in order that the magnetizing force produced by it, and represented by curve A', Fig. 4, may have its proper value relative to B and C.

If in Fig. 12 we connect in both primary coils of transformer No. 1—for a moment not considering the effect of the boosting transformer—it would be equivalent to plotting curve A', Fig. 4, to a value of 200. Hence the two-phase current obtained would be unbalanced because A' would be much higher than D. On the other hand, if we use only one coil, A' would have to be drawn proportional to 100, which is obviously too low. By adding a third transformer with its secondary connected in series with coil A', Fig. 12, and exciting the primary winding as shown, it is possible to obtain a boosting effect sufficient to raise A' approximately to its proper value. Very satisfactory results have been obtained in this manner from three transformers each of which had three secondary coils; by cutting out one or more of which, it was possible to obtain perfect two-phase currents.

It may not be out of place to state, that in order to prove that you have two-phase current, the middle wires of the secondary coils should be joined as shown by the dotted line. In this case, supposing there are 100 volts across from F to G and H to I, there should be 141 volts from F to I, or whatever voltages are obtained should have the relation of 1 to 1.41.



FIGS. 8 TO 11.—CLOCK DIAGRAMS.

On the Oxidation of Carbon at Ordinary Temperature By Means of Atmospheric Oxygen With the Production of Electrical Energy.*

BY WILLARD E. CASE.

A SUBJECT of much interest at the present time is the production of cheaper energy from coal, avoiding the losses inherent in the methods now employed. The potential energy of carbon may be converted into electrical energy direct by means of atmospheric oxidation at normal temperature, obtaining in the form of electricity the equivalent of the chemical process, and thus avoiding the limitations due to the second law of thermodynamics.

It was to establish the foregoing proposition so far as possible that the following investigation was undertaken, an acid solution of ferric chloride was chosen as the carrier of the atmospheric oxygen to the carbon:

I.—That carbon reduces ferric chloride solution to ferrous, with the production of carbon dioxide.

II.—That ferrous chloride solution can be reoxidized to ferric, by atmospheric oxygen; and

III.—That platinum and carbon when opposed to each other in ferric chloride solution, produce electrical energy with the oxidation of carbon to CO_2.

To establish that carbon reduces ferric chloride solution to ferrous, with the production of carbon dioxide, the following experiments were made as to the reducing power of lampblack, wood-charcoal, sugar-carbon and coke on $Fe\ cl_3$ solution:

In each case the carbon was used in several successive reductions without being heated above 130° C, and only for the purpose of drying. The sugar-carbon used in the final experiment, in which the $Fe\ cl_3$ was completely reduced to $Fe\ cl_2$, was used at least five times, and it acted as strongly the last time as the first.

50 *c. c.* of $Fe\ cl_3$ solution used, contained .875 *g.* of iron, which solution was shaken in a bottle with 3 *g.* of lampblack for five minutes. The solution was filtered as rapidly as possible and was then tested for ferrous iron, with negative results. The same operation was conducted with wood-charcoal with positive results; and the reduction was found to be 2.42% of the iron in the solution.

As upon the purity of the carbon employed the success or failure of the experiment rests, greater care was taken in the determination with sugar-carbon, it being considered to be the purest.

The purified sugar-carbon after being ground to pass through a 100-mesh sieve, was heated to a white heat in a Rose crucible, into which a stream of dry nitrogen was passing. After ten minutes, the lamp was removed and the carbon allowed to cool in nitrogen. It was then transferred to a glass tube filled with nitrogen, and the tube attached to a mercury air pump and exhausted. (The pump used gives a vacuum of less than five-millionths of an atmosphere.) When the gas had been drawn from the tube as completely as possible, the tube was heated until it was of a dull red color, and nitrogen was then let in, until a normal pressure was restored, and the tube was allowed to cool. This process of exhaustion, heating, re-exhaustion, and allowing to cool in nitrogen, was repeated twice, and the carbon was then made to act on $Fe\ cl_3$ solution prepared as follows:

50 *c. c.* $Fe\ cl_3$ solution was heated nearly to the boiling point, and allowed to cool under an atmosphere of nitrogen in a glass stoppered cylinder. About 3 *g.* of sugar-carbon was introduced into the cylinder and the solution shaken for five minutes. The solution was then filtered as rapidly as possible and the reduction determined by a standard solution of potassium dichromate. It was found to amount to 10.2% of the iron present. The reduction obtained in a like solution of $Fe\ cl_3$ with 3 *g.* of sugar-carbon, which may have contained some occluded gases, was 10.98%. The difference, however, may have been due to other causes.

To determine whether the reduction could be made complete, a small flask of 100 *c. c.* capacity was used, containing 50 *c. c.* of the $Fe\ cl_3$ solution, having .2851 *g.* $Fe\ cl_3$; hydrogen was passed through it until all the air was driven out; 3 *g.* of sugar-carbon was then introduced into the flask in an atmosphere of hydrogen—no air being admitted. The experiment was conducted in parallel. The yellow color of the ferric chloride became less pronounced, and at the end of five days had disappeared, when, on opening the flask, the solution being tested for ferric iron, only a trace was found.

To determine the CO_2 formed in the second flask, which was run in parallel, the ordinary method of determination was used.

The weight of the $K\ O\ H$ bulb and $Ca\ cl_2$ tube used had increased .0189 *g.*, which equaled the CO_2. According to the equation ($4\ Fe\ cl_3 + C + 2\ H_2O = 4\ Fe\ cl_2 + 4\ H\ cl + CO_2$) the .2851 *g.* $Fe\ cl_3$ would require .005263 *g.* *C.* for its reduction; and .005154 *g.* was found in the CO_2, which seems to satisfactorily prove the equation.

It now became of interest to determine, approximately, the rise of temperature due to the oxidation of the carbon by chemical reaction. Therefore, in each of two 100 *c. c.* flasks were placed 50 *c. c.* of $Fe\ cl_3$ solution containing 2.62 *g.* $Fe\ cl_3$. These were permitted to stand until they were at the same temperature, 27.4° *C.* 2 *g.* of sugar-carbon was then introduced into one of the flasks, and the flasks were agitated for five minutes side by side by a shaking machine, when the solution containing the carbon was found to be at

*A paper read by title before the Royal Society, June 15, 1899.

a temperature of 27.75° *C.*, while the other flask containing no carbon, had a temperature of 27.5° *C.*, showing an increase of .25° *C.*

Having proved that CO_2 is formed during the reduction of the ferric chloride by the carbon, it seemed essential to show that the oxidation was complete and that no *CO* was formed. For this purpose, the ordinary process was employed. And it was found that no trace of *CO* had been developed in the $Fe\ cl_3$ solution. On testing the $Fe\ cl_3$ solution the usual reduction was found to have taken place; and it was further ascertained that there was no CO_2 in the sugar-carbon, because some of the carbon was put into a flask with water instead of $Fe\ cl_3$ and the water boiled to drive out all gases. The same chain of apparatus was used as before, but there was no indication of CO_2 in the $Ba\ (O\ H)_2$ solution. A solution of $Fe\ cl_3$ is not reduced by hydrogen or by carbon monoxide, water gas, producer gas or illuminating gas.

The next proposition was to determine that ferrous chloride solution can be reoxidized to ferric by atmospheric oxygen.

The rate of oxidation of the ferrous chloride by air or oxygen or the maintenance of the ferric chloride solution in its ferric condition, is an important factor, since the efficiency of this solution as a carrier of oxygen and therefore the activity of the cell as a generator of electricity, is determined by this maintenance.

Apparatus for determining the oxidizing power of air on ferrous chloride solutions:

Four gas-washing bottles in series, "A," "B," "C," "D":

A.—Contained distilled water.

B.—Contained ferrous chloride (without acid).

C.—Contained distilled water.

D.—Contained ferrous chloride (20% sol. of *H cl*).

The gas-washing bottle "A," contained water to saturate the air with moisture. Bottle "C" contained water to wash the air and saturate it again as at first.

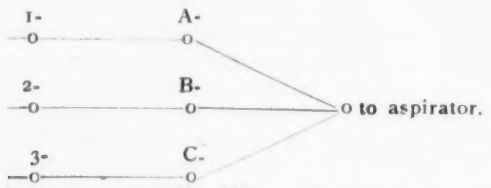
In "B," the 25 *c. c.* $Fe\ cl_2$ contained .8823 *g.* *Fe*, of which .8343 *g.* were ferrous iron. Therefore, 5.44% of *Fe* was ferric.

"D" contained a similar solution (acid with *H cl*, as above).

Air was aspirated through the apparatus for 18 hours. At the end of that time, the ferric iron in "B" had increased from 5.44% to 5.8% of the total *Fe*. The ferric iron in the acid solution in "D" had increased to 6.8% of the total, or 1% more than in "B."

Further determination of oxidizing power of air on ferrous chloride solutions:

The apparatus was arranged as follows:



The circles indicate gas-washing bottles: 1, 2 and 3 contained distilled water for saturating the air with moisture.

A.—Contained 25 *c. c.* $Fe\ cl_2$ sol.

B.—Contained 25 *c. c.* $Fe\ cl_2$ sol. and *lg.* platinum black.

C.—Contained 25 *c. c.* $Fe\ cl_2$ sol. and a like amount of fine pumice-stone.

The $Fe\ cl_2$ solution was of exactly the strength for the best electrical conductivity: 1 *c. c.* $= .0947$ *g.* *Fe*, $= .213$ *g.* $Fe\ cl_2$.

and contained no ferric iron.

Air was drawn through the bottles at the same speed and the process continued for 24 hours. At the end of this time, the *Fe* (ferrous) was again determined and in bottles "A" and "C" it had fallen to 95.02%. In bottle "B" it had fallen to 93.14%, showing that while the pumice stone had caused no change in the rate of oxidation, the platinum black had increased it by 1.88%.

To keep the solutions from depositing basic compounds, an excess of *H cl* was added to each 25 *c. c.* of the iron solution.

Oxygen was drawn through a similar system: after 24 hours, the ferrous iron had fallen to .0867 *g.* per *c. c.*, showing that 8.23% had been oxidized, while air had only oxidized 6.88% of the iron.

Air was passed for 18 hours in the presence of platinum black through a solution of ferrous chloride of which .74% of the iron was ferric. Afterwards, an analysis showed 5.45% ferric iron. The rapidity of the oxidation also depends on the smallness of the bubbles of air introduced, and on the surface of the liquid exposed. It was found advisable to have an excess of *H cl* present. Further experiments have shown that $Fe\ cl_3$ is completely reduced by carbon to $Fe\ cl_2$ and changed from $Fe\ cl_2$ to $Fe\ cl_3$ by oxidation—with air.

It having been shown that carbon does reduce ferric chloride solution to ferrous with the production of carbon dioxide and that the ferrous chloride solution can be reoxidized by atmospheric oxygen, and its rate determined, it was next in order to demonstrate that electrical energy can be produced as a result of this oxidation.

To do this, a single fluid cell was constructed, having as a positive electrode finely powdered sugar-carbon in a porous cup from which the air was exhausted, so far as possible before and after it was immersed in the cell containing solution of ferric chloride which, owing to the vacuum, filtered into the cup and filled it, thereby doing away in a great measure with the atmospheric oxygen present in the carbon. A platinized platinum sheet was used as the negative electrode.

The e. m. f. equaled .2 volt, and on short circuit, a current of .1 ampere which soon dropped to .05 and then slowly decreased, reading .01 after eight hours. Being permitted to stand on open circuit for twelve hours, with oxygen slowly passing through the $Fe\ cl_3$ solution, it regained its original e. m. f.—.2 volt. It was then short-circuited for 24 hours, when the circuit was broken, and after remaining open for 12 hours, it recovered its e. m. f. to .15 volt and gave .05 ampere on short circuit.

A like cell was set up, with the exception that $Fe\ cl_2$ was drawn into the porous cup containing the carbon for the purpose of supplying ferrous chloride therein, and immediately approached the conditions which would otherwise require time, as the reducing power of carbon on ferric chloride is slow. The positive electrode was then immersed as before, in ferric chloride solution. The e. m. f. of this cell was .25 volt. After short-circuiting, it gave .2 volt, and an hour after it had regained its original e. m. f.

This type of cell soon polarizes, owing to the formation of CO_2, due to the oxidation of the carbon in the cup.

To simplify the cell and do away with the porous cup thus eliminating to a great extent its internal resistance, a positive carbon electrode was made by mixing powdered sugar-carbon with caramel syrup and drying and carbonizing it at a red heat. This electrode was substituted for the porous cup in the solution of $Fe\ cl_3$ of a *spg.* of 1.2 in a cell of 800 *c. c.* capacity; to which was added 3 *c. c.* of *Hcl.* The water of the solution was first boiled to remove the air, the electrode was then immersed in the electrolyte, and the cell placed under the receiver of an air pump for the purpose of freeing the carbon from air so far as possible, because while air remains it oxidizes the solution at the positive electrode quite as much, if not as rapidly, as the carbon reduces it, thereby setting up a counter e. m. f. The e. m. f. of the cell equaled .06 volt. Oxygen was introduced, passing slowly through the solution near the platinum electrode.

The readings taken were as follows:

Time. P. M.	Volts.	Amperes.	Resistance.	
9:00	.06	.0	..	Open circuit.
9:30	.05	.0	..	Open circuit.
9:36	.022	.04	.6	Closed circuit.
9:40	.02	.03	.6	
10:10	.016	.028	..	

Another cell using carbon in dilute ferric chloride solution opposed to platinum in concentrated ferric chloride solution in a porous cup gave an e. m. f. of .1 volt.

Graphite opposed to platinum in ferric chloride solution gave an e. m. f. of .01 volt. It was found, as would be supposed, that the e. m. f. was higher and the oxidation more rapid the finer the powdered carbon of the electrode.

Liquid cells in which carbon can act as final reducing agent and air as an oxidizer:

Two glass beakers, "A" and "B," containing $Fe\ cl_2$ solution, connected by an inverted syphon, filled with the same ferrous chloride solution, having platinum conductors in each beaker; the e. m. f. equaled 0. Air was passed through solution in "A," and the current flowed one way. The solutions were then poured out, mixed, and replaced. Air passed through solution in "B," current in the reverse direction, which demonstrated that air oxidizes the solution through which it is passed and that a two-fluid cell is formed in which the most ferric solution is negative to the ferrous solution.

Now, to further accentuate this type of cell, two electrodes of platinum wire from the same piece were cleaned and heated to a red

heat and afterwards immersed, one in a ferric and the other in a ferrous chloride solution in two beakers, connected as before by an inverted "U" syphon tube, glass wool in the tube acting as a porous diaphragm. The e. m. f. equaled .06 volt; the ferrous chloride solution acting as the oxidizable or positive electrode.

Experiments were made with cells of this type, using a porous cup to separate the two solutions; the e. m. f. varying with the dilution or concentration of the solutions: an e. m. f. as high as .44 volt and a current of .8 of an ampere on short circuit has been obtained from a cell of 300 *c. c.* capacity. Platinized platinum electrodes were used in each instance. Ferric opposed to ferrous sulphate, gave an e. m. f. of .2 volt.

Careful determinations were made with a two-liquid cell having a semi-permeable copper ferrocyanide film, in a porous cup, separating the ferric from the ferrous chloride solution. In the porous cup there was 200 *c. c. Fe* cl_3 of *spg.* 1300; the outer jar contained 500 *c. c. Fe* cl_2 of *spg.* 1300; platinized platinum electrodes were used. Oxygen was slowly passed through the *Fe* cl_3 solution, and from analysis it appeared that 17.06 *g. Fe* had changed from ferric to ferrous, and that in the outer cell 16.72 *g. Fe* had changed from ferrous to ferric.

In setting up the cell a few drops only of *H cl* were added to the ferric solution in the porous cup. A larger quantity of *H cl* would have permitted more rapid oxidation and a less proportion of *Fe* would have undergone the change from ferric to ferrous.

This cell gave, when first assembled, .32 volt on open circuit, and .16 ampere through external resistance of 1. ohm. It was kept in operation, with occasional intervals of rest, for six days, giving at the end of that time .03 ampere, through an external resistance of the ammeter only. The total current furnished by the cell was equivalent to 7.5 ampere hour.

If one *g.* carbon will reduce 52.187 *g.* of *Fe* cl_3 to *Fe* cl_2 containing 17.985 *g. Fe*, it would require .94857 *g.* carbon to change the 16.72 *g. Fe* from ferric to ferrous formed in the outer cell. To produce this 7.5 ampere hours, taking the electro-chemical equivalent of carbon as .000031176, the *g.* per ampere hour equivalen. is .11176; this 7.5 the current obtained, = .86683 *g.* of carbon required.

If the ferric chloride solution be kept ferric by atmospheric oxygen, and the ferrous chloride solution be kept ferrous by constant or intermittant reduction by carbon, there will result a constant e. m. f. A thin film of oil was used to cover the ferrous chloride to protect it from atmospheric oxidation.

After these experiments were finished and notwithstanding that the carbon was used in several successive reductions, acting as efficiently the last time as the first, it was deemed advisable to prove that the reducing action of the carbon on the ferric chloride solution was due to the carbon alone, and not to occluded reducing gases therein. To this end sugar-carbon was heated and cooled in an atmosphere of nitrogen, and was then introduced into a Plücker tube, containing nitrogen; the tube was then attached to a mercury air pump and as perfect a vacuum as possible was produced in it. After heating the tube several times and repeating the exhaustion process between each heating, pure dry nitrogen was let into the tube under slight pressure, equal to 5.5 inches of water. The tube was again exhausted, and when a sufficient vacuum had been produced, a current from a coil capable of giving a four-inch spark was passed through it and its spectrum examined. The spectrum was of nitrogen, with sufficient hydrogen to show the *C* and *F* lines of the solar spectrum; the tube was then heated, and the exhaustion repeated until the nitrogen spectrum became rather faint, and the hydrogen *C* line was just visible. This hydrogen spectrum was undoubtedly due to the moisture produced by the gas flame used in making the tube. The tube was then filled with dry nitrogen and sealed.

To prove that this pure carbon in reducing the solution of *Fe* cl_3 would produce an electrical current by oxidation as the other carbon had done, a small cell was made up by fusing a platinum wire through the closed end of a test tube; the wire inside the tube was coiled into a spiral at the bottom; the cork perforated to receive a glass tube, and the wire for the other electrode was fitted to the open end of the cell. The pure *Fe* cl_3 solution was introduced into the cell and nitrogen was run in to displace the air. The upper end of the glass tube extending through the cork was closed by a rubber tube and pinch-cock, and the cell was put into circuit with a tangent galvanometer. The current produced was too small to be read even to the fifth decimal place. The closed end of the Plücker tube containing the carbon was filed and then slipped into the rubber tube and the tip broken off; the carbon was then shaken down into the cell without coming in contact with the air, and as soon as it had reached the bottom in contact with the platinum wire conductor, the galvanometer at once showed an e. m. f. and after a time rose to 5.9 milli-volts. The *Fe* cl_3 solution in the cell which at first contained no *Fe* cl_2 was found, after twenty-eight hours, to have a considerable amount of it, showing its reduction.

As suggested by the author in 1888* the direction of experiments in the future will be to find some cheap substance which will absorb oxygen from the air, and give it up to the carbon; in fact, acting as a carrier of oxygen, so oxidizing it without heat; and this is not improbable, as we already know of substances which do this, though giving a low e. m. f. Thus, for instance, the ferric salts are reduced to ferrous by agitating their solutions with carbon, being regenerated by absorbing oxygen from the air. By pursuing this line of investigation, we can be sure we are not ignorantly striving against any law of nature when attempting to convert the whole potential energy of carbon into electrical energy.

While in the foregoing experiments ferric chloride was used as the carrier of oxygen, without doubt other substances will be found which will be more active and efficient.

Electrical Standardization—III.**

RISE OF TEMPERATURE.

Under regular service conditions, the temperature of electrical machinery should never be allowed to remain at a point at which permanent deterioration of its insulating material takes place.

The rise of temperature should be referred to the standard conditions of a room temperature of 25° C., a barometric pressure of 760 mm. and normal conditions of ventilation; that is, the apparatus under test should neither be exposed to draught, nor enclosed, except where expressly specified.

If the room temperature during the test differs from 25° C., the observed rise of temperature should be corrected by ½ per cent. for each degree C.† Thus with a room temperature of 35° C., the observed rise of temperature has to be decreased by 5 per cent., and with a room temperature of 15° C., the observed rise of temperature has to be increased by 5 per cent. The thermometer indicating the room temperature should be screened from thermal radiation emitted by heated bodies, or from draughts of air. When it is impracticable to secure normal conditions of ventilation on account of an adjacent engine, or other sources of heat, the thermometer for measuring the air temperature should be placed so as to fairly indicate the temperature which the machine would have if it were idle, in order that the rise of temperature determined shall be that caused by the operation of the machine.

The temperature should be measured after a run of sufficient duration to reach practical constancy. This is usually from 6 to 18 hours, according to the size and construction of the apparatus. It is permissible, however, to shorten the time of the test by running a lesser time on an overload in current and voltage, then reducing the load to normal, and maintaining it thus until the temperature has become constant.

In apparatus intended for intermittent service, as railway motors, starting rheostats, etc., the rise of temperature should be measured after a shorter time, depending upon the nature of the service, and should be specified.

In apparatus which by the nature of their service may be exposed to overload, as railway converters, and in very high voltage circuits, a smaller rise of temperature should be specified than in apparatus not liable to overloads or in low-voltage apparatus. In apparatus built for conditions of limited space, as railway motors, a higher rise of temperature must be allowed.

In electrical conductors, the rise of temperature should be determined by their increase of resistance. For this purpose the resistance may be measured either by galvanometer test, or by drop-of-potential method. A temperature coefficient of 0.4 per cent. per degree C., may be assumed for copper.‡ Temperature elevations

* "Transactions of the American Institute of Electrical Engineers. Special meeting, Jan. 10, 1888. Subject: Electric Energy from Carbon Without Heat."

**Report of the Institute Committee on Standardization of Generators, Motors and Transformers.

†This correction is also intended to compensate, as nearly as is at present practicable, for the error involved in the assumption of a constant temperature coefficient of resistivity; *i. e.* 0.4 per cent. per deg. C. taken with varying initial temperatures.

‡ By the formula $R_T = R_t\ (1 + 0.004\ \theta)$ Where R_t is the resistance at room temperature, R the resistance when heated, and θ the temperature elevation $(T-t)$ in degrees centigrade.

measured in this way are usually in excess of temperature elevations measured by thermometers.

It is recommended that the following maximum values of temperature elevation should not be exceeded:

Commutating machines, rectifying machines and synchronous machines:

Field and armature, by resistance, 50° C.

Commutator and collector rings and brushes, by thermometer, 55° C.

Bearings and other parts of machine, by thermometer, 40° C.

Rotary induction apparatus:

Electric circuits, 50° C., by resistance.

Bearings and other parts of the machine 40° C., by thermometer.

In the squirrel cage or short-circuited armatures, 55° C., by thermometer, may be allowed.

Transformers for continuous service:

Electric circuits by resistance 50° C., other parts by thermometer 45° C., under conditions of normal ventilation.

Reactive coils, indication and magneto regulators:

Electric circuits by resistance 55° C., other parts by thermometer 45° C.

Where a thermometer, applied to a coil or winding, indicates a higher temperature elevation than that shown by resistance measurement, the thermometer indication should be accepted. In using the thermometer care should be taken so to protect its bulb as to prevent radiation from it, and, at the same time, not to interfere seriously with the normal radiation from the part to which it is applied.

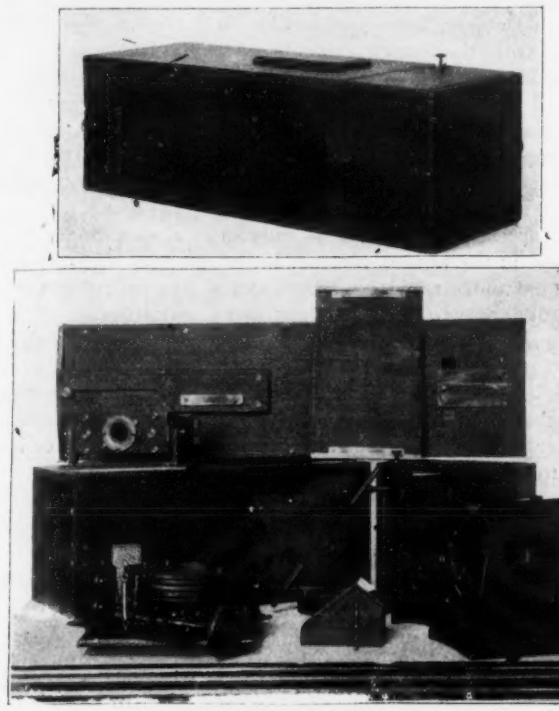
In the case of apparatus intended for intermittent service, the temperature elevation which is attained at the end of the period corresponding to the term of full load, should not exceed 50° C. by resistance in electric circuits. In the case of transformers intended for intermittent service, or not operating continuously at full load, but continuously in circuit, as in the ordinary case of lighting transformers, the temperature elevation above the surrounding air-temperature should not exceed 50° C. by resistance in electric circuits and 40° C. by thermometer in other parts, after the period corresponding to the term of full load. In this instance, the test load should not be applied until the transformer has been in circuit for a sufficient time to attain the temperature elevation due to core loss. With transformers for commercial lighting, the duration of full-load test may be taken as three hours, unless otherwise specified. In the case of railway, crane and elevator motors, the conditions of service are necessarily so varied that no specific period corresponding to the full-load term can be stated.

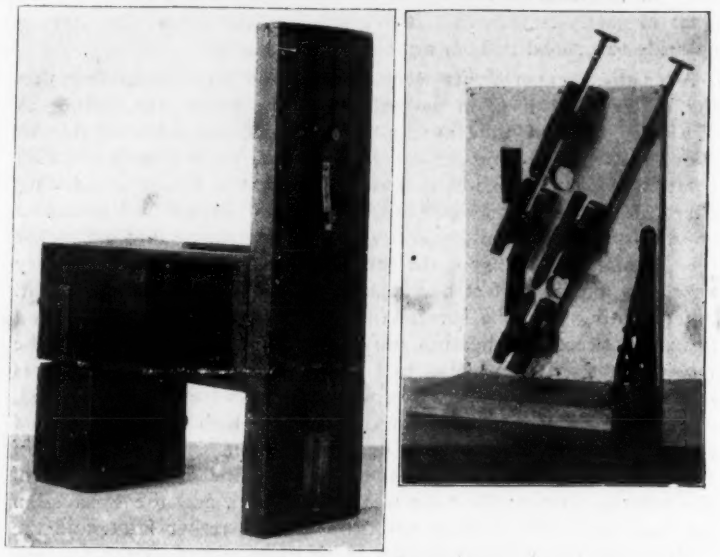
A New Wrinkle in Cooling Machines.

A novel application of thermodynamics to domestic purposes has recently turned up in the shape of an air cooling apparatus for offices, apartments and habitations. It is a somewhat radical departure from previous methods in that the source of the cooling is not, as generally heretofore, the conversion of mechanical work into the abstraction of heat either directly or indirectly, but merely depends upon the enormous latent heat of vaporization of water. Water from any convenient source is supplied in a thin film to the copper top of a flat convoluted air flue and a sharp air blast is directed axially along and over this flue from a special little blower motor. The forced evaporation chills the air flue vigorously and drops the temperature of the whole air blast from 10° to 20° F., according to the rate of evaporation attained. The net result of this arrangement, the details of which are here only sketched roughly, is to send out into the apartment to be cooled about 10,000 cubic feet of air per hour cooled to a temperature of about 68°, on an expenditure of about 100 watts. By adjusting the machine the air supplied can be sent out without any added moisture or with such a degree of humidity as may be desired and the temperature may likewise be varied, although as usually adjusted the temperature of the air delivered is controlled automatically within a few degrees range. Obviously such an apparatus is not intended or adapted for cold storage work or the like, but within the range required for effective house cooling it is enormously more efficient than any machine which depends on the degradation of mechanical energy. The new machine is manufactured under patents to Dr. Louis Bell and is about to be placed on the market.

A Portable Apparatus for Photographing Curves of Two Variable Currents Simultaneously.*

An article by H. J. Hotchkiss, describing and illustrating the apparatus and its uses, is published in the March number of the Physical Review. The instrument gives continuous simultaneous records of two variable currents or potential differences so as to show their corresponding values at any instant within the limits of the curves. The variations, whether cycle or non-cycle, are recorded as fast as they occur, the special province of the apparatus being in experiments dealing with rapid non-cycle variations. The





FIGS. 1, 2, 3 AND 4.—GALVANOMETERS AND MOUNTING.

corresponding values of any number of cyclic curves may be obtained by taking two, then one of these with a third, and so on.

The principal parts are two quick acting galvanometers of the Deprez type with minute moving parts supported by a quartz fiber in the strong field of a permanent magnet. These are mounted one above the other in one end of a case about 6 x 6½ x 18 inches, shown in Fig. 1. In the other end of the case is a revolving drum carrying a photographic film. The arrangement of parts inside may be seen by referring to Fig. 6.

Sun light or arc light is directed through two narrow slits in the side of the case upon the very small mirrors of the moving parts, which we will call the needles. From the mirrors the two beams are reflected upon a horizontal slit in the drum-box. As the needles are deflected by the current in the galvanometer coils the

*A brief description was given in The Electrical World, Sept. 26, 1896.

spots of light move along the slit and trace the curves on the film which moves rapidly at right angles to the slit. The drum-box may be removed and replaced by a slideway for using plates, as seen in Fig. 3, in which the drum-box is used simply as a support for one end of the case.

FIG. 5.—FIBER SUPPORT.

The needle is a very small piece of soft iron mounted on one side of a quartz fiber with a mirror, about one-third as large as the iron, on the other side. The fiber is supported vertically in the instrument. A medium size for the iron is: 1 mm. wide, 1.9 mm. long with rounded ends, and .06 mm. thick. The long dimension is vertical along the fiber so as to make the moment of inertia small and the frequency of natural vibration high.

The fiber is supported at both ends on a quartz bow or rod about 1 mm. in diameter and 1 cm., or less, in length. The bow is then mounted in a groove, cut lengthwise in the side of a 5-32-inch rod,

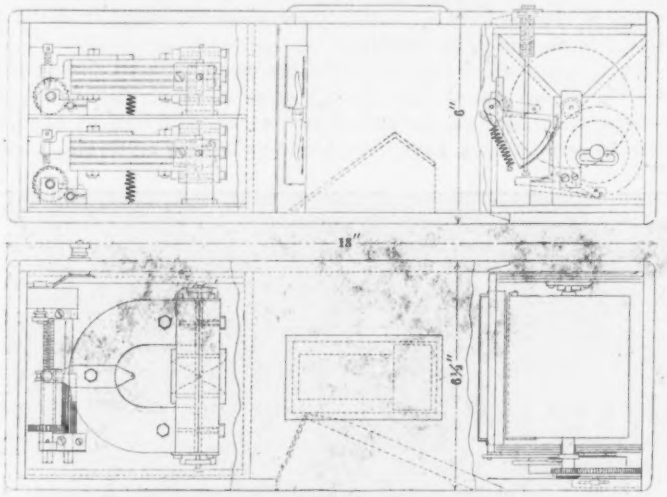


FIG. 6.—ARRANGEMENT OF PARTS.

about 4.5 cm. long, so that the fiber lies in the axis of the rod, as shown full size in Fig. 5.

The quartz fibers are mounted on quartz in order to avoid the effects of temperature changes as far as possible.

Needles have been made having a natural frequency of over 8,500 double vibrations per second in the comparatively weak field of a permanent magnet weighing about 1.3 kilos. With a strong field and a stiff fiber a frequency of 10,000 double vibrations per second could be obtained.

The needles are interchangeable so that those of different frequencies and degrees of sensitiveness may be used for different purposes.

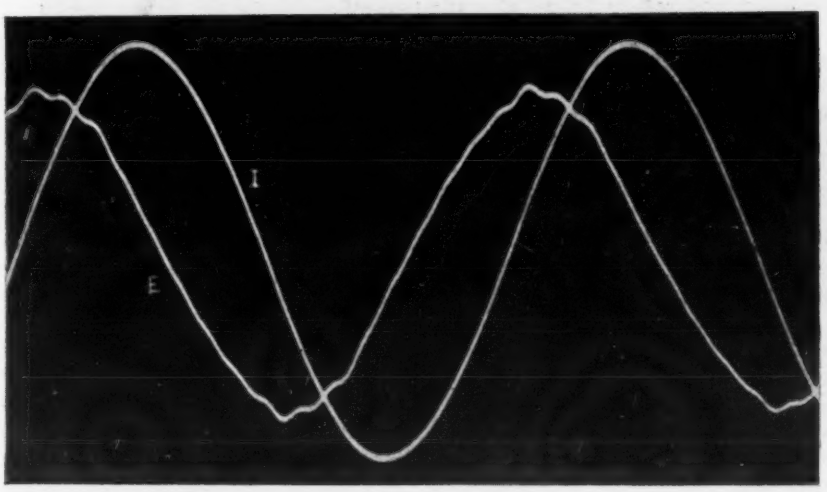


FIG. 7.—CURVES WITH SOLENOID, NO IRON.

The galvanometer coils are likewise interchangeable and may also be connected either in series or parallel. In the galvanometers shown in Fig. 2, one has about 35 turns of number 16 wire in each coil and the other 600 turns of number 30 wire B. & S. gauge, the outer diameter of the coils being 2.5 cms. and the resistances .07 and 17.4 ohms respectively, when each pair is connected in series.

The parts of the galvanometers may be seen in Figs. 2 and 6. The needle rod, coils, and soft-iron pole pieces[1] are held in position between the magnet poles by a two-part hard rubber block which in turn is supported on a base so as to move about a horizontal and a vertical axis through the needle for the purpose of adjusting with-ated by a key through a small opening in the side of the case. The out displacing the needle. The rear of the magnet is carried side-wise by a screw and moved vertically by a cam, both being oper-spots of light are thus properly adjusted on the slit of the drum box or slideway. For convenience in adjusting, a block on which are two inclined mirrors is placed directly below the opening in the top of the case. In one the galvanometer fronts are in view, and in the other are seen the lines of light on the slits.

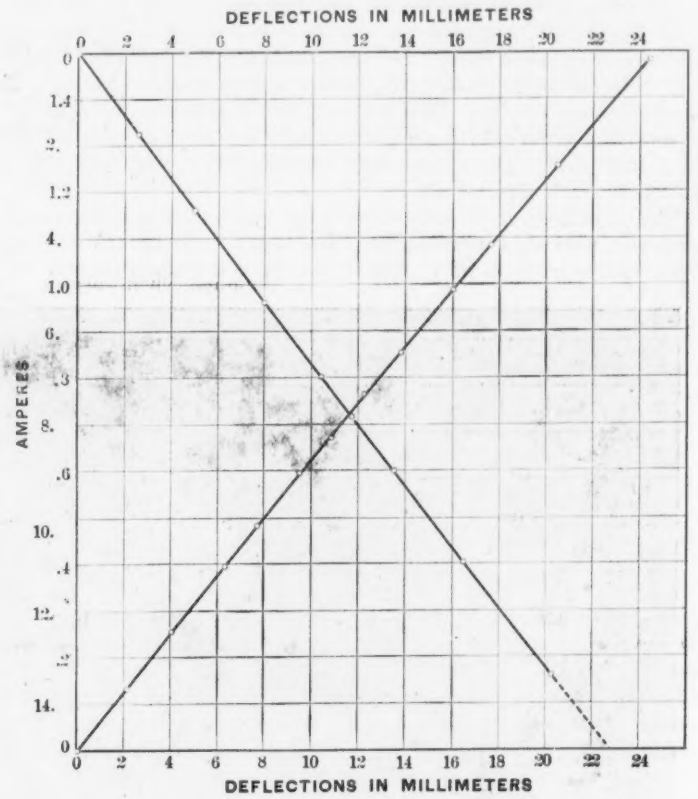


FIG. 10.—CALIBRATION CURVES.

When the adjustments are made the galvanometer circuits are closed, and, if films are used, the photograph is taken by pressing the push button seen on the top of the case in Fig. 1. This releases the driving mechanism, which brings the drum up to speed and then automatically operates the shutter which

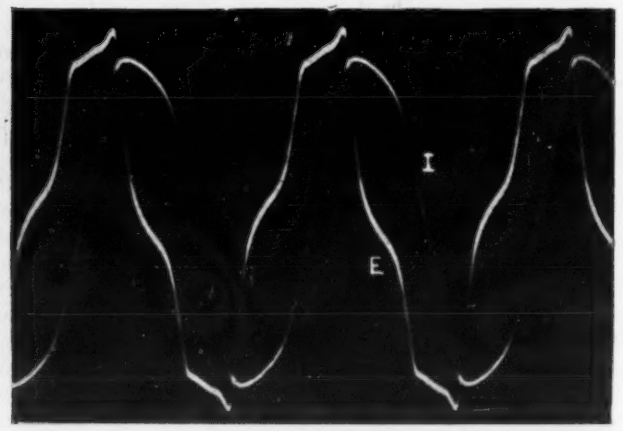


FIG. 8.—CURVES WITH SOLENOID ON TRANSFORMER.

exposes the film for a single revolution of the drum, beginning and ending the record at the latch that holds the ends of the film. How this is done may be better understood by noting the interior arrangement in the horizontal and vertical projections in Fig. 6, and

[1]The pole pieces are 2.5 cm. wide and .48 cm. thick, with the ends next to the needle rod tapered down to about 3 mm. wide and 1 mm. thick. These tapered points are not shown in Fig. 6, owing to the small scale.

also Fig. 2, in which it is taken apart showing the inner drum case with its lid removed ready to take out the drum for putting on the film.

If the slideway shown in Fig. 3 is used instead of the drum, it is operated by giving the thumb nut at the end of the spring a one-fourth turn either way, thus releasing the spring which withdraws a pin on which the plateholder rests. The plate is then shot downward by a strong spring acting on the pin in the slot at the top. The spring ceases to act upon the plate just before it comes to the slit. A vent at the bottom for the escape of the air can be adjusted so as to maintain the speed of the plate very nearly uniform while passing the slit; probably within one-tenth of one per cent. A latch keeps the plate from bounding back after striking the felt pad at the bottom.

In Figs. 7-9 are shown a few curves representing current and electromotive force from alternators having different wave forms, and different kinds of external circuits containing resistance, self-induction or capacity. They were taken on plates 2.5 by 8 inches except Fig. 9, for which a full-sized 5 by 8 plate was used instead of a half plate. The curves are reproduced full size, but only a part from each plate is shown.

The laboratory transformers, used for Fig. 8 are operated from a 2200-volt alternator running at a frequency between 128 and 130 cycles per second, e. m. f. Fig. 7 was obtained when current was supplied by a 12.5-ampere, 29-volt special alternator having a frequency of 60. The ripples on the E curve, due to a grooved armature core, are entirely removed from the current curve by the solenoid in the circuit. In Fig. 8 also the forms of the curves differ very much, due to the solenoid. The frequency in this case was 130, the generator being of capacity of 10 amperes at 106 volts.

The electrodes of the electrolytic cell used for Fig. 9 consisted of an arc light carbon with a helix of No. 10 aluminum wire around it and about 1 cm. away. These were placed in a saturated solution of alum with a little sulphuric acid added. The zero line was traced by a fine wire placed across the slit in the slideway. The shadow of the wire made a break in the curve every time the beam of light crossed it. The alternator furnishing current generated 30 volts at a frequency of 17.

The cell allows a comparatively large current to flow from carbon to aluminum, but offers great opposition to the flow of current from aluminum to carbon in the cell. The E curve shows the difference of potential around both the cell and the current galvanometer; hence the fall of potential in the latter must be subtracted from the ordinates of the E curve to give the difference of potential impressed at the terminals of the cell. One centimeter deflection represents .555 ampere for the I curve, and 10.82 volts for the E curve. The fall of potential in the current galvanometer is 9.35 volts for each centimeter of ordinate of the current curve. Fine wire coils of high resistance were used for both galvanometers for Fig. 9.

From the data given the values in the following table were obtained for the parts of the curves above and below the zero lines in Fig. 9.

	Fig. 9.	
	Above.	Below.
Maximum volts for E curve	7.04	5.28
" amperes for I curve	.39	1.76
" volts on cell	36.	11.
Volts for zero current	+30.	−4.
Direction of current in cell	Al. to C.	C. to Al.

The lack of symmetry of the E curve is due to the drop in the resistance (about 1 ohm) between the generator and the apparatus.

The curves may be made heavy, or light and narrow. To obtain narrow lines with sunlight it is directed upon the needle mirrors from reflectors, about 1 mm. wide, placed about 1 meter from the needles. The slit in front of the plate is about .5 mm. wide. The line of light across the slit may be made even narrower than that. no lenses are used. The small mirror gives an image in much the same way as a pinhole camera.

When using arc lights no reflectors need be used, but narrow slits should be placed close to the arcs. One arc lamp and one reflector may be used instead of two arcs. The pair of hand-fed arcs shown in Fig. 4, have been found to be very convenient, being light and easily adjusted. Turning the screw changes the length of the arc. Pulling and pushing the screw moves the arc up and down on the slides. The bottom of the metal slit is bent around the lower carbon. The maximum intensity of light is nearly horizontal on the side towards the slit. The round windows in the upright are covered with colored glass for viewing the arc while adjusting it. The upright is covered with asbestos board. The terminals on the back are connected to the metal slides. The screws are insulated from the circuits.

The instrument shown in Figs. 1-3 is the only one that has been made. It was constructed (except the needles and slideway) by Mr. F. C. Fowler, the instrument maker to the Department of Physics, Cornell University. The ingeniously arranged driving mechanism and shutter for the drum-box were devised by him to replace the ones designed by the writer and are a great improvement. Apparatus of different forms for special uses has been devised.

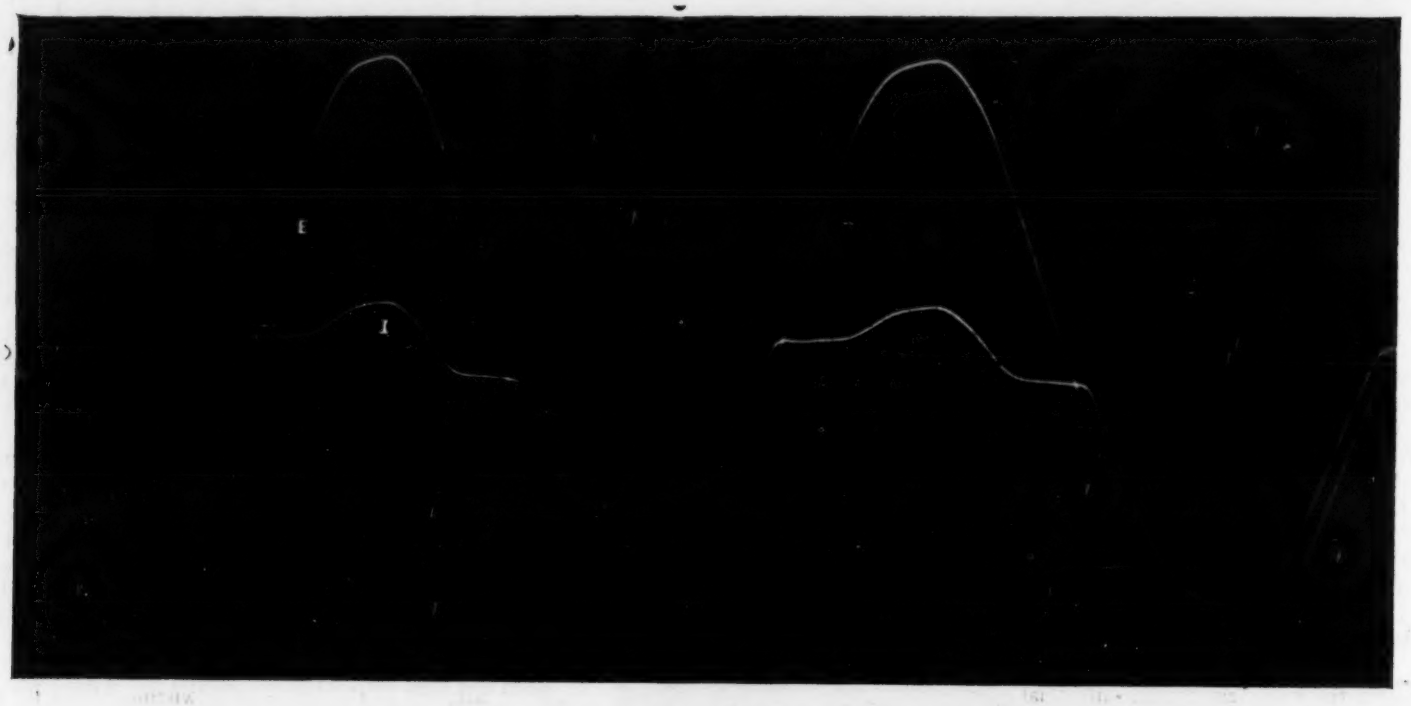


FIG. 9.—CURVES FOR CELL WITH CARBON-ALUMINUM ELECTRODES.

Generating Electricity by the Action of Sea Waves.

A patent was granted July 11 to Max Gehre, of Rath, Germany, for a mechanism having for its object the utilization of the energy of sea waves. By means of floats, vertical motion is given to rods, which produces a relative displacement of the core and coil of an induction coil, thereby setting up in the latter a current.

American Types of Automobiles—III.

SPERRY ELECTRIC CARRIAGES.

FOR the last two or three years, Mr. Elmer E. Sperry, of Cleveland, who has long been identified with the development of electric traction engineering, has concentrated his thoughts and energies upon the subject of automobilism, making sundry advances and improvements in that field which have been covered by patents. Although Mr. Sperry's work has attracted very favorable attention in Paris, it had not been brought directly to the notice of the public in this country until last month, when Mr. Sperry presented a very able and interesting paper on "Electric Automobiles" at the general meeting in Boston, of the American Institute of Electrical Engineers. Mr. Sperry's work in this country is being done in association with the well-known Cleveland Machine Screw Company, for which he is electrical engineer, and to them and him we are indebted for the opportunity to illustrate the vehicle shown in our "insert" this week. The details given out are by no means complete, but Mr. Sperry, on account of patent features, prefers to defer the full measure of publicity to a later date. The illustrations and data give, however, a clear idea of the principles upon which Mr. Sperry is working.

In his Institute paper Mr. Sperry prefaced his description of tests, etc., by remarking that in 1889, "motor mortality" had been brought so low as to render electric traction commercially feasible, giving the world the rotary type of motor of which it had been in search, and of which other motive powers for traction were still in need. Meantime there had been extraordinary advances in the perfection of the storage battery, bringing at once within the range of practicality the modern automobile. The perfected storage battery, said Mr. Sperry, presents some remarkable features. It even rivals the electric motor in its fitness and special adaptability to the automobile problem. Its very large reserve power at instant command; its entire freedom from danger when fully charged; its almost constant pressure throughout its capacity; its recently developed capacity for quick charging; and ease with which charge may be obtained in almost any hamlet in the country, are among its advantages. He stated from personal tests of the principal types of batteries built on the Continent and in England that most of the published records are trustworthy as to specific capacity at the various rates. Some of the structures, however, are open to serious objection from the standpoint of vehicular traffic. Fortunately materials are at hand and systems of developing the plates perfected that render them thoroughly reliable and commercial to a degree commensurate with their life. The recent claim of one maker that batteries light enough for traction purposes would live through 5,000 full discharges is hardly credible, though the negatives of some special types seem to indicate a near approach to this figure. The engineer is at present engaged in increasing the life of the light positive, with every indication of success, at least beyond the point ensuring commercial requirement.

It has been supposed that compressed air is the ideal stored power, but it is safe to say that electric storage distances it in the important features. Compressed air reservoirs weigh about 85 pounds per cubic foot capacity for air at 2000 pounds pressure to the square inch, the air itself weighing nearly 11 pounds. It is found that by adding to the air a large quantity of heat, at extra cost, by compounding cylinders and using pressure reducers and wire drawing valves, all with added weight, that about .27 of a horsepower hour may be obtained. We know that this weight of storage battery, will develop 1½-hp hours, requiring no reducing valves and maintaining its pressure practically at one point until exhausted, rather than gradually exhausting the pressures, as with air. This straight line of discharge of the batteries is not matched by any other storage system of which we have knowledge.

With regard to his tests on tires, and the nature of the roadway, Mr. Sperry stated that tests were made with a vehicle, having two driving wheels, supplied with smooth, wide-faced steel tires, 72" in diameter, carrying 60 per cent. of load. The approximate draw-bar pull was ascertained on various kinds of pavement, dirt and gravel roads and macadam, on the level, and on grades, wet and dry. It was found that under the most adverse circumstances, ample adhesion could be relied upon for any conditions liable to be met. Soapy and greasy Belgian block pavement was found to give most trouble, but even here, 20 per cent. draw-bar pull could easily be relied upon, with some, but not serious, slipping. A lasting impression of the adhesion and value of smooth tires for road traction, is made by seeing a vehicle of this kind, ascending a 20 per cent. grade on an ordinary gravel road and rising easily uphill over a 4" x 4" timber, placed in front of first one and then both the driving wheels, working as well on the wet portions as on dry.

Coming directly to the vehicle shown in the insert, Mr. Sperry pointed out the importance of rendering the vehicle dirigible and controlling the guiding mechanism easily, and particularly in regard to meeting obstructions, so that the mechanism should not be deranged or the vehicle be thrown out of its course. Many attempts have been made to reduce the leverage of reaction, but at best it has remained a problem of some importance. Figs. 1 and 2 show the method employed by Mr. Sperry. Tests designed to thoroughly demonstrate the practical operation of the device, and especially to compare it with the one ordinarily employed, are illustrated in Figs. 3, 4 and 5. It was found that the amount of side-thrust transmitted to the guiding handle was practically in proportion to the leverage measured by the distance between the steering axis and the plane of the wheel, at the height of the point of interception of the obstruction. A 20" controlling handle was connected for equal angular movement on the swiveling axles, the wheels being the same diameter, viz., 32" and loaded with the same weight, viz., 370 pounds. A small obstruction causes so flat a trajectory curve as to be negligible; this curve is seen at X Y (Fig. 5). Mr. Sperry has used, as the height of obstruction, the smallest dimension of an ordinary Belgian paving block, lying upon its side, assuming this to be the standard obstruction to be encountered by the various wheels in these tests. Operating the two devices each a number of times over this obstruction, at different speeds, a moment of effort upon the handle, tending to swing it laterally, or snatch it out of the grasp of the operator, was found to be in the two cases as follows:

Fig. 2 author's device; mean value for pull = 0 lbs.
Fig. 4 ordinary device; mean value for pull = 10¾ lbs.

This shows an entirely different action under practical operating conditions.

It will be seen from Fig. 2 and 3 that the steering axis AB is made to intersect the plane of the wheel well up from the bottom or ground line, where obstructions are encountered and where they may be met "head on," and therefore entirely neutralized, as has been demonstrated, giving no tendency to deflection of the wheel in either direction.

Mr. Sperry has also found that the arrangement gives the vehicle a quality of self-centreing, or running straight-forward, hands off. This, as will readily be seen, is a natural result of the obliquity of the steering axes. The wheels, when turned, in the act of guiding, describe a conic section, the lowest point of which is the straight-forward running position. Another peculiar feature is, that in this action, each wheel is entirely independent of the other, throwing no stress either upon the connecting or guiding rods. Another excellent effect is the result upon the tires, the act of steering tending to describe a small arc, rather than the usual twisting of the tires. This is specially noted when the vehicle is standing still, and the test is applied. Fig. 6 shows the inner wheel turned at an angle of 45 degrees.

The subjects of motor and gear were next taken up by Mr. Sperry, who said that it is found with automobiles that while the best practice in tramway traction can be followed closely in the main, yet the different conditions under which the vehicles operate, weight of motor permissible, height at which the motors are mounted, enormous variation in the rolling friction factor, and other points, allow of departures, which have an important bearing on the motor design and construction. For instance:—With the automobile, only a small motor is allowable. This should be light and yet should deliver all the power necessary in case of emergency. It is found practical to use a motor with a somewhat increased ratio of copper to iron, which should have a high overload capacity, but more than all, it is found that the size and weight of the motor can be greatly reduced, if the gears can be practically compounded. This is especially desirable owing to the enormous variation in the rolling friction factor. The elevated position of the motor and the comparatively open space it occupies, when compared with street car motors, enables the employment of ventilation. This should be designed with care, so as to prevent ingress of water and moisture. The ventilation is especially applicable to the small sized motor considering the heavy overloads to which they are frequently subjected.

Obstructions and grades are encountered never met on tram-

tracks and at the same time may be coupled with soft road, which, owing to the weights necessarily present, would render progress impossible, unless an inordinately large motor were at hand. At such times, often if a few only can be compassed the journey can be resumed. It is under these and similar conditions, that the value of the compound gear becomes apparent. One form of this gear, employed in a number of vehicles, Mr. Sperry stated, has been found to be entirely satisfactory, increasing the leverage of the motor over the load. In case of a motor, with a suitable over-load factor, this gear, while only doubling the leverage, is found to compass anything that has ever been encountered in city, park and country service. Any ratio of gearing can of course be employed. By means of the compound gear, the torque is brought up to nearly the slipping point of the drivers without overdraft of current-supply from the battery. The manipulation is by a small handle, usually imbedded in the cushion at the side, it being used only at infrequent intervals. This lever attaches to the upright arm seen in Figs. 7 and 8, the gear just being visible. This compound gear not only enables a small motor to meet an emergency, but has an important bearing upon the storage battery, acting as safeguard in a very important sense, preventing, as it does, inordinate overdrafts of electric current, and in this way, enabling lighter plates to be employed, without fear of "shedding" the active material. Another feature of importance in connection with the compound gear is found to be its interlock and interaction with the controller. This feature renders the compound gear entirely successful in the most incompetent hands. The gear cannot be thrown or changed, when the current is on, nor can the current be put on until the gear is entirely thrown to either one or the other of its normal operative positions. This is done automatically and without the knowledge of the operator.

We come next to that important feature, the controller, and as Mr. Sperry said, in the hands of the non-expert, simplicity of control is found to be indispensable to satisfactory operation. With the automobile, there is one handle, which always should be kept in hand, viz., the steering handle. The question naturally arises, "why not let this handle do all of the work of controlling the vehicle?" In a paper before the Institute, in 1894, Mr. Sperry pointed out a system of tram car control, which has since been widely adopted, in which starting, stopping, speed control and brake were confined to the operation of a single handle. This having now been classed as the best practice with tram cars, why not, he argues, utilize the combination in connection with the steering handle, allowing it, by the most natural and almost trivial movements, to do the whole work of operation. In this way, the entire control of the vehicle is simplified to a single handle. The direction of the vehicle is controlled by lateral movement of the lever, the vehicle going in any direction to which the handle is pointed or aimed. Depressing the handle, from notch to noth, increases the speed, and pulling up the handle, as one would draw in the reins, in case of emergency, instantly turns off the current and applies powerful brakes. The intensity of the brakes is increased as the handle is further raised. When the speed has been reduced, by again lowering the handle, any of the speed notches can be readily picked up; the speed and brake being always under instant control, one hand only being engaged. It is apparent that the current manipulation to the motor and brakes requires only an imperceptible effort. In propulsion, the controlling handle is made either to stay where placed, or is self-raising to the brake position, to suit the fancy of the owner. The controlling handle lying nearly horizontal, the "aiming" action in steering completes the almost ideal simplicity of the operation.

The controlling head, which is shown in the figures, is supplied with an indicator showing at all times the position of the controlling cylinder. Fig. 9 shows first speed and Fig. 10 the third speed, and by touching a button on the side (seen in Fig. 1) the handle may readily be raised to the position shown in the figure, for convenience of occupants, especially for getting in and out on driver's side.

In crowded thoroughfares, the brake is the most important feature of the automobile. The French authorities in passing upon vehicles, insist upon this factor more than any other, and it is certainly the most indispensable. Whatever else the vehicle can or cannot compass, it must be possible to stop it, and that instantly, on occasions. The brake should be powerful and at least in duplicate. The carriages illustrated herewith are each provided with three separate brake systems.

The location of the controller beneath the foot board as seen in Fig. 11 is found to present decided advantages in point of convenient interlocking and interconnection with the brakes. The motor cannot be started without first removing all the brakes. This location gives ready access at all times and upon all sides by the hinged floor; gives a natural interlock between the controller and the compound gear above referred to, and also between the controller and charging terminals, which are also here located. Numerous accidents and even wrecks have been caused from failing to open a special motor switch, when placing the controller in series position for charging. A simple interlock, with the charging terminals entirely eliminates this danger, and indeed the interlocking system throughout the carriage very thoroughly protects it in inexperienced hands; for instance, if the directing indicator (seen in Fig. 2 and 12) is removed, the motor and controller are locked. If the index or pointer of this indicator points forward the vehicle will go forward. If to the rear, the vehicle will go backward. If it points upward as seen in Figs. 6, 9 and 11, the carriage may be charged, but when in this position, all the conductors of the motor cable are automatically open-circuited, preventing accident. The pointer can never be manipulated until the controller is first open-circuited, and if the index is only partially turned, through carelessness, or otherwise, the controller cannot be operated until the mistake has been corrected.

The motor being light and small, normally should be of relatively "high speed," still farther reducing the weight. A small motor is possible with the compound gear. The double reduction motor possesses advantages of allowing the hand-brake to be operated on the intermediate shaft, thus working through the compensating gear. A small brake, in this way, gives all the leverage necessary, being one reduction back through steel gears with small peripheral velocity, thus acting without noise. Another advantage of double reduction is in keeping all the gears of the power system small, and thus insuring a neater appearance. The somewhat higher speed permissible in the double reduction arrangement also renders possible the bipolar motor, with its higher efficiency, as compared with the multipolar. Every condition tending to higher efficiencies should be considered in connection with automobile equipment, as conserving the resources of the battery. These conditions are not as necessary with systems of tram traction, where the prime source of power is always available.

The location of the controller and current-manipulating switches low, as seen in Fig. 11, and in front of the batteries, avoids hydrogen detonation and eliminates all danger of explosion from spark or opening circuit.

Much has been said of one motor versus two. This is largely a matter of mechanics; it is conceded that one motor gives higher efficiency than two of half the power, and is less expensive to maintain. As even the heaviest strains are comparatively small, the compensating gear, where one motor is employed, is easily maintained, yielding a combination which is far simpler and employs less parts than with a double motor equipment.

The automobile will, for some time, necessarily be in the hands of the inexperienced and non-expert, and while it is not possible to render it "fool proof," yet certain safeguards may be employed in and about its operating devices and charging system, which will materially reduce and almost prevent derangement. The manipulation may be so thoroughly interlocked as to effectually prevent a wrong operation preceding the right one, and rendering it nearly impossible to make a mistake in anything like normal operation. Interlocks and safety devices are used in many branches of engineering; the introduction of automatic interlocking switches is a notable example, having placed steam railway operation on an entirely new basis. After subjecting these devices to continued practical test, and altering them until the requirements seem to have been met, Mr. Sperry ventures to say that there is no reason why the important results reached in the interlocking switch and signal system, should not be compassed in automobile manipulation, and by devices vastly simpler and inexpensive.

As to charging and care of batteries, Mr. Sperry believes that the differential wattmeter system for ordinary use, coupled with the periodic inspection by an expert from the home office or local headquarters, is the best arrangement now at our command. He has found that the differential factor of the wattmeter should be adjustable and should be brought from time to time into step with both the efficiency and charging curves of the battery. These curves change and are peculiarly altered by the time factors. These adjustments are easily made through determinations by the use of hydrom-

eter. This can easily be one of the duties of the periodic inspection above referred to. The practical employment of the adjusting feature, or in fact, any device, by means of which the meter may be kept in step with the battery, is found to constitute such a meter an almost perfect safeguard against the destructive effects of overcharge and overdischarge in inexperienced hands. One tray of the batteries as used by Mr. Sperry is shown in Fig. 13. The arrangement is compact and minimizes spilling the acid in case of a jolt or shock.

In conclusion, it may be stated that Mr. Sperry's aim in this and the other automobiles of his design is to get the highest possible efficiency combined with simplicity. As to the service secured, the fact may be noted that the carriages shown in the insert run 75 miles over roads of varied character on a single charge of the battery, weighing less than 700 pounds.

CURRENT NEWS AND NOTES.

A FRENCH-ITALIAN TELEPHONE CONFERENCE.—A telephone convention between France and Italy was recently signed in Rome. It is subject to ratification by the parliaments.

A NINE DAY RACE has been started in France with automobiles to continue this week. The distance to be run is 1428 miles and thirty departments will be crossed by 67 competitors.

CANADIAN PACIFIC CABLE.—The Imperial Government has advised the Dominion Government that it has yielded on the Pacific cable question, and that it will carry out the original agreement by bearing with Canada ten-eighteenths of the cost of the work.

WIRELESS TELEGRAPHY IN THE WEST INDIES.—A despatch from Kingston, Jamaica, states that the Government of Trinidad has decided to adopt the Marconi system of wireless telegraphy for communication with the dependency of Tobago.

CONSOLIDATION OF STEEL TUBE INTERESTS.—The consolidation of the wrought steel and iron tube and pipe industry of the United States, with a capital stock of $80,000,000, has been completed. The annual output of the works at present is about 1,100,000 tons, and it embraces hundreds of varieties of steel and iron goods, including steam, gas and water pipes, electric conduits, etc., etc.

WIRELESS TELEGRAPHY TEST.—A Vienna despatch states that the military engineers who have experimented with the Marconi system of wireless telegraphy using balloons, one captive and one free, report that results were sufficiently satisfactory to justify further experiments. It is stated that the signals were clearly transmitted for a time, but were interrupted afterward.

THE TELEGRAPH IN BRAZIL.—After encountering many difficulties, The Amazon Telegraph Company, it is stated, has decided to abandon the cable in the River Amazon from Para to Manaos. The company is, however, building a land line with some reaches of cable. It has issued bonds in the sum of $600,000 with interest at five per cent. A subsidy of $85,625 a year for twelve years was granted to the company by the Brazilian government.

WESTINGHOUSE COMPANY TO ESTABLISH A PLANT IN ENGLAND.—Information, corroborated, but not fully confirmed in this country, comes from London to the effect that the Westinghouse Company has acquired 100 acres of land near Manchester on which it will immediately erect works covering 40 acres and practically duplicating its Pittsburg plant. The enterprise is aided by £1,500,000 British capital. It is stated that Lord Kelvin will be the electrical adviser of the company.

AUTOMOBILES IN THE ARMY.—The United States Signal Corps is about to test the automobile for use in war. Several machines have been ordered with the request that three be furnished at the earliest practicable date. If the tests are in favor of the machine its use will be extended to Cuba, Puerto Rico and to the scene of actual hostilities in the Philippines. Signal Corps men say that in case any garrison were suddenly attacked re-enforcements in men and light artillery could reach such posts in much quicker time.

AUTOMOBILES FOR THE COLLECTION OF MAIL MATTER.—The Post Office Department at Washington is considering the advisability of using automobiles for mail-collecting wagons in the large cities. It is proposed to try the automobile in Washington in place of the horse-drawn wagons. An electric vehicle can be operated much cheaper because the wagon can be lighted by electricity and the same energy utilized in operating the stamping machines. If the experiment proves successful in Washington, automobiles will be tried in other cities. In our last issue reference was made to experiments of this nature recently made in Buffalo. Postmaster Dorr, of that city, sent a favorable report to Washington.

A CHILIAN ELECTRIC LIGHT PLANT.—The March 18, 1899, issue of the *Chilian Times*, published in Valparaiso, Chili, contains illustrations and a brief account of the electric light station at Punta Arenas. This plant was installed by the Westinghouse Electric & Manufacturing Company and started on Sept. 17, 1898, for the "Compania Luz Electrica de Punta Arenas." The company is formed entirely of local capital. The installation is the furthest south of any electrical establishment in the world, and was originally placed with the intention of lighting the dwelling houses and stores in the town; but a contract has been recently signed for 250 street light of 32-cp each. For this a duplicate plant of electric machinery has been ordered, the first one not being of sufficient capacity to satisfactorily light both dwelling houses and streets.

SOME CONVENIENT PRIMARY BATTERY CONSTANTS.—A contributor sends us the following constants which may often be of use in primary battery calculations. Theoretically one pound of zinc will develop just 1-hp hour in a primary cell, if the E. M. F. is .2 volts (accurately 1.994). For any other voltage the consumption of zinc per hp hour is, of course, inversely proportional to the voltage. This assumes that there is no local action. If the above is the difference of potential on closed circuit instead of the E. M. F. on open circuit, then this consumption of zinc refers to the useful output, and the energy lost in the internal resistance need not be considered, unless with respect to efficiency. In any battery, regardless of the voltage, one pound of zinc will develop 374 ampere hours theoretically, that is, not including the local action. One pound of bichromate of soda as a depolarizer corresponds theoretically to 277 ampere hours.

WENT TO BOSTON BY TROLLEY.—A. I. Prime, a New York lawyer, his wife and his sister, Mrs. M. S. Valentine, and her daughter Edith arrived in Boston on July 13, from New York, having traveled almost the entire distance by trolley. A car was boarded in Yonkers for New Rochelle at nine o'clock on Tuesday morning, July 11. New Haven was reached the first day. The next morning the trip was continued through Hartford to Springfield, from there to Worcester, where the second night was passed. The last stage was accomplished on July 13, the forty-eight miles to Boston being done in a little over five hours. The trip took about twenty-nine hours, exclusive of stops. Two hundred and five miles were covered by trolley and only fifty-two by train. Thirty different lines were passed over. It is waggishly suggested that Mr. Prime wants to consolidate them all as an express service between the two cities competing with the steam railroads.

TELEPHONES ON STREET CARS.—The new motor cars which are to be used on the suburban line between St. Paul and Stillwater will be equipped with a complete system of telephonic communication with the main office. As the new road is a cross country line, there will be miles of open country between stations. In case of accident when the cars are out in the country, it is important that the motorman should be able to communicate quickly with the home office. For that purpose each car is supplied with a telephone placed in the front vestibule. The telephones are nicely adjusted by springs so the jolting of the car will not destroy the delicacy or impair the efficiency of the instruments. At the feed poles, which are placed a quarter of a mile apart, the motorman can "plug" in his telephone and open communication with the head office. In case a train is disabled or snowed in, the main office can be advised of the condition and relief despatched. The telephone will also be useful in arranging passing points for the cars if it should be necessary to do so. A brief description of this road was published in these columns, July 1 last.

WELSBACH LAMPS.—It is interesting to note that according to the annual report of the Welsbach Light Company, 4,934,337 lamps and mantles were sold last year, as against 2,800,600 in 1898. The increase was reported due to a cut in prices.

3750 MILES BY AUTOMOBILE.—At two minutes after eleven o'clock a. m., on July 13, Mr. and Mrs. John D. Davis started from Greeley Square, New York City, on their automobile trip of 3700 miles to San Francisco. After leaving the city they will follow the river road to Albany, and cross the state to Buffalo, thence to Chicago. This is the longest trip ever undertaken with an automobile, and will be watched with interest.

SEARCHLIGHT CAUSES RELIGIOUS FERVOR AT DAYTON, O.—On the night of July 13 a powerful searchlight used in a local factory jubilee was repeatedly thrown on a certain clump of clouds, which hung directly over a church in Byron, a village twenty miles distant, where a church lawn fête was in progress. The fête was broken up into a hysterical prayer meeting, and religious excitement prevailed for hours, as the people believed it was a sign that the end of the world had come.

WIRELESS TELEGRAPHY IN HAWAII.—A despatch from Victoria, B. C., says: "Marconi's system of wireless telegraphy is to be put in operation in Hawaii as a means of communication between the different islands of the group. An organization has been formed, capital has been subscribed for the project and some material for the system is already on the way. There is only one channel between the islands in the group that is wider than the English Channel. That is the one between Oahu and Kauai, and to the minds of the promoters of the enterprise communication across that is the only part of their plan which is problematical."

TROLLEY REAR-END COLLISION.—Attention is called by *The Philadelphia Press* to the need of providing trolley cars with a light that will burn even when connection with the feed wire is broken, and so prevent rear-end collisions, like the two which occurred recently, one in Pittsburg and one in Philadelphia, and both attended with loss of life. In each case the car had stopped because of some trouble with the machinery, and as the lights were all out, a following car dashed into it at full speed. *The Press* suggests as an easy protection against this danger that the rear end of each trolley car be provided with a red lamp burning oil. The electric headlight in front answers every purpose for which it was designed, and when the car itself is illuminated no rear light is necessary, but when the current is cut off by some accident, if the disabled car happens to stand in a dark place, the chance of a destructive collision is alarming. A small storage battery outfit would be better than an oil lamp and would be more compact.

NEW FORM OF CONVERTER.—A patent was issued July 11 to Seth K. Humphrey, of Boston, for a converter to transform polyphase electric currents from one voltage to another and at the same time from alternating to direct current. The apparatus, as illustrated, consists of a stationary laminated disk carrying the windings, a commutator and brushes revolved by a synchronous motor. The core is solid with the exception of a series of circularly disposed holes, through which the primary conductor is threaded, each turn passing over the periphery of the core. The secondary is a continuous winding similar to that of a Gramme ring, distributed either over, under or by the side of several sections of the primary winding. This secondary is tapped between each coil, the taps being connected with the segments of the stationary commutator. In order to assist the primary winding in maintaining a rotating magnetic field of uniform speed and intensity an auxiliary winding extends across the disk and is connected in parallel with the primaries.

LEADING-IN WIRES.—A patent was issued July 11 to S. O. Cowper-Coles, of London, England, having for its object the production of metallic conductors as a substitute for platinum for use as leading-in wires or strips in the manufacture of incandescent lamps, vacuum tubes, etc. The body of the conductor is chemically pure iron produced by electrolysis, which is passed through a bath consisting of an alloy not readily oxidizable and of low melting point, such that it will become fused when the heat necessary for the sealing in of the conductor is applied. This bath consists of an alloy composed of 50 parts of tin, 25 parts of lead, 24 parts of cadmium and 1 part of aluminum; it is found advantageous to cover the surface of the bath of molten alloy with zinc chloride, or other suitable flux. In applying the wires to the lamps or tubes they are first covered with a thin coating of glass and then sealed in in the ordinary manner. It is stated that pure iron expands in almost the same ratio as glass, which, moreover, combines with the coating metal of low fusing point, thus forming a perfect seal.

THE PARIS AUTOMOBILE EXPOSITION.—Gustave Rives, general manager of the recent automobile exhibition in Paris, states that the exhibition was a grand success from every point of view. "We have a substantial balance in our favor after paying all expenses. The total receipts were between 325,000f. and 330,000f. Whatever surplus we have will doubtless be devoted in part to the coming automobile race from Paris to St. Petersburg, in much the same way as the surplus of the first exposition was used in connection with the Paris-American contest. At the exhibition a great feature in regard to automobile construction was the prominence given by the manufacturers to the voiturette, which is a class of vehicle between the large automobile and the tricyclette. Large automobiles cost a good deal of money, and the tricyclette does not supply the requirements of a certain class of buyers. Now, it is just here that the voiturette comes in, and its cost, about eight hundred dollars, enables very many pepole to purchase an automobile now, from which they have hitherto been prevented on account of the question of money. The area taken up by the exposition was 40,000 square metres. The stands cover 10,000 square metres, the number of exhibitors was 450 and the vehicles 500, which is double that of the preceding year."

STORAGE BATTERIES.—Among the patents issued July 11 are three relating to storage batteries, the patentees being Charles Risdale, of Chicago, Ill.; J. C. Howell, of London, England, and Charles Pollak, of Frankfort-on-Main, Germany, respectively. The first-mentioned patentee describes an element consisting of a plate of active material with vertically-disposed V-shaped projections or grooves. Imbedded in the plate is a conducting strip sinuously extending through the body thereof. The V-shaped ridges are hollow and perforations in the walls permit the electrolyte to enter. The positives and negatives are similar in shape and interlock, the projections of one plate fitting into the grooves of another, but are insulated from each other by a thin sheet of insulation of some absorbent material. The Howell patent describes a form of helically-wound metallic ribbon. The ribbon is formed by fixing a lead tube to a mandrel, revolving it in a lathe, and by means of an acute angled knife or cutter, shearing a thin ribbon therefrom having a thickness of from 1-100 to 1-600 of an inch. As the ribbon is cut it is crinkled, thus producing, when wound on a second mandrel or core, a series of spaces or interstices between the turns, which permit comparatively free access of the electrolyte to all parts of the surface of the ribbon. Owing to the method of cutting the ribbon, it coils on the core in conically disposed, crinkled layers. The Pollak patent describes a method of forming plates. The inventor states he first ascertained that under certain conditions a lower degree of oxidation than peroxidation may be obtained provided a predetermined critical voltage is not exceeded. In the case of electrodes at one volt, the resulting products will be sub-oxides of lead of a gray color and other lead salts poor in oxygen; at a higher voltage there will be orange-colored oxides very nearly approaching red lead; while with an e. m. f. of over 2 volts peroxide of lead will form. The inventor's process, therefore, consists in a preparatory operation of formation at low voltage, the temperature of the cell being preferably kept at 40 degrees C. In this operation one storage cell will in the first stages of formation prove a sufficient source of electricity for two new cells connected in series. A sufficiently deep layer of lead oxide is thus formed, and then the usual method is applied for completing the formation. The advantage claimed is that the time of formation is much reduced. In lead plates of the Planté formation, the positives soon become covered with a thin though dense film of peroxide of lead which hinders the electrolytic action, owing to the difficulty of penetrating the plates. The claim of the patent is for a process of forming lead electrodes in storage batteries, consisting in first treating them as anodes with a current having a tension of less than 2 volts per element, thereby producing a covering of red oxide of lead, and then completing the formation by the use of a current having an e. m. f. in excess of 2 volts.

EXPORTS OF ELECTRICAL MATERIAL FROM NEW YORK.—The following exports of electrical material are from the port of New York for the week ending July 11: Antwerp, 39 packages electrical material $2553; Amsterdam, 1 case electrical material $100; Argentine Republic, 2 cases electric motors $30; British Guiana, 4 cases electrical material $200; British East Indies, 16 cases electrical material $288; British Possessions in Africa, 21 cases electrical material $997; Berlin, 3 packages electrical machinery $1169, 4 packages electrical material $5759; Central America, 4 cases electrical material $54; Chili, 10 packages electrical material $667; Cuba, 28 packages electrical material $207, 88 cases electrical material $1210; Christiania, 2 packages electrical material $22; Glasgow, 6 cases electric motors $80; Genoa, 3 cases electrical material $130, 3 cases electrical machinery $119; Hamburg, 73 packages electrical material $6081, 107 packages electrical machinery $2550; London, 29 packages electrical material $1454; Liverpool, 27 packages electrical material $3796; Marseilles, 247 cases electrical material $21,250; Milan, 2 cases electrical material $200; Mexico, 12 cases electrical material $315; Newfoundland, 6 cases electrical material $83; Nova Scotia, 2 cases electrical material $19; Odessa, 28 cases electrical material $780; Puerto Rico, 18 cases electrical material $297; Rotterdam, 7 cases electrical machinery $350, 2 packages electrical material $31; Southampton, 3 cases electrical material $132; U. S. of Colombia, 43 cases electrical material $1388; Venezuela, 57 cases electrical material $446.

LETTERS TO THE EDITORS.

Ironclad Insulators.

To the Editors of Electrical World and Engineer:

Sirs: Your editorial on "Insulators as Targets" interested me very much, as that is a form of trouble that I have so far been unable to do away with. Can you tell me if it is possible to buy the old style ironclad insulator now? I remember since reading your editorial having seen a few of them on corner and ridge irons in Boston in the early days of telephony, when there was no such thing as an exchange but numerous private lines.

FROSTBURG, MD. W. M. LANNAN.

President Glidden's Million Out of Reach.

To the Editors of Electrical World and Engineer:

Sirs:—President Glidden is quite secure. He will keep his million dollars in his own possession. A relaying telephone is a problem every telephone man has tackled. I satisfied myself of its theoretical impracticability in 1878. Since then I have had to examine hundreds of attempted solutions. It is an insoluble problem, for it involves not only restoration of lost energy, but in that highly complicated undulatory form assumed by vocal sonorous vibrations in speech. All attempts to reinforce telephone currents mean serious reduction of clearness in articulation for the components—the upper partials—that give to the voice its timbre, are wiped out of existence. W. H. PREECE.

LONDON, Eng.

Telephone Repeaters.

To the Editors of Electrical World and Engineer:

Sirs: In view of the recent increased interest in the subject of telephone repeaters, doubtless many of your readers besides myself would welcome a discussion upon the apparently diverse views held by writers upon the subject.

There have recently appeared apparently equally authoritative statements supporting each of the following positions:

1. That telephonic repeaters, capable of repeating speech in either direction over a line, are commonplace, and while not entirely satisfactory, are sufficiently so to have come to some extent into use.

2. That while repeaters capable of satisfactorily repeating speech in one direction are well known and are used to some extent, no satisfactory method has yet been devised by which they can operate in both directions.

3. That no repeater capable of repeating at all exists, but that in all probability the repeated efforts of inventors will produce one; that methods of arranging circuits are, however, known which will undoubtedly permit a successful repeater, when discovered, to operate in either direction.

4. That no satisfactory repeater exists, and no system permitting double operation of such a repeater has ever been devised, and that neither of the same can ever possibly be produced without some radical departure from the lines of invention which have thus far been followed out.

Expressions of opinion, explaining which of the above statements is nearest to the actual facts would, I think, be very timely.

EDMOND CONGAR BROWN.

NEW YORK.

Autobaine.

To the Editors of Electrical World and Engineer:

Sirs:—The mechanical or self-propelled vehicle for use on streets is drawing so much public attention and meeting with its approval and demand so rapidly, that it seems strange that no satisfactory name has as yet been given these vehicles, and as this question is one that has come up recently in some of the papers, I have taken the idea under consideration, and I believe, finally solved the problem.

In such vehicles the name horseless carriage, automobile, motovehicle, electric carriage, auto-car, electro-mobile, gasoline wagon, etc., cannot be used when speaking of the operator and retain the name of the vehicle, or distinguish the sex of the operator, or in fact, distinguish the operator at all, let alone any distinction of the act of running such a vehicle. What is required is a name that in speaking of an operator of either sex or the act of driving, will carry with it the name of the vehicle itself, and also a name broad enough in its application to apply to any form of self propelled vehicle, whether electric, gasoline, steam or any other form of motive power.

The name I wish to suggest to the public is a name which fulfils all of these requirements, and that is the name autobaine, which translated means, automatic wagon. Baine, being derived from an old Greek word, meaning wagon; so we have for the name of the vehicle, autobaine, autobaineer, as applied to a man operator, autobaineeress, as applied to a woman operator, and autobaining or autobaineering for the act of using the vehicle, in addition to which this name is applicable to any kind or form of self propelled vehicle.

I sincerely trust for your co-operation and adoption of this name.

C. E. WOODS.

CHICAGO.

Two-Phase Versus Three-Phase Systems.

To the Editors of Electrical World and Engineer:

Sirs: I had no intention of taking part in the two-phase and three-phase controversy initiated by you. Some of the statements in Mr. Blondel's letter, especially as interpreted in the editorial gloss, are of such a nature that they cannot be allowed to pass unquestioned.

First—Mr. Blondel says: "The independence of two-phase circuits exacts the employment of two separate transformers and of four line conductors instead of three." If he means absolute independence, this is correct, and is even an under-statement, as independent generators and prime movers would be required also. Taking it in a relative sense, however, the statement is erroneous, for two-phase three-wire circuits are independently controllable; that is to say, the e. m. f. of one circuit can be varied without practically affecting the other, and this is not the case with three-phase three-wire circuits. As to the statement as to the effect of the influence of one circuit on the other, as interpreted editorially, Mr. Blondel should regret that the effect is so small, since a lowering of the e. m. f. in one circuit when it is lowered in the other would tend toward producing a uniform electro-motive force in the phases. No doubt in any given circuit, other things being equal, it is desirable to make the drop with load as small as possible, but it is not desirable, unless feeder regulation is used, that one circuit should not cause a drop in the other. On the contrary, if we could so design a machine that the load of one circuit would reduce the e. m. f. in the other as much as in its own, such a machine would be in simple cases much easier to handle than the existing ones. The trouble with the three-phase winding is not that one circuit affects the other two, but that

it affects those in opposite directions, so that while depressing one it raises the other.

My experience does not lead me to agree with Mr. Blondel as to the trend of practice in the design of alternators. I take it that the tendency in this country, at least, is to closer inherent regulation. For myself, I regard the compounding of alternators, if compounding is to be taken literally, and especially of polyphase alternators with varying power-factor loads, as barbarous.

Second—My work has largely been of such a nature as to render me very particular on the subject of harmonics. I have not found any trouble from them in a four slot per pole two-phase winding. If, however, Mr. Blondel says that, theoretically, on this point the three-phase winding is superior, I would defer to his authority, although convinced from experience that any such superiority must be worthy of only academic attention.

Mr. Blondel's fourth point would be very good if he were arguing that there is a place for the three-phase system and not that there is none for the two-phase. While the use of three-phase transformers may suffice to give substantially equal e. m. f.s on the three circuits, the conditions under which such use is permissible are rarely to be found in this country. Practically, their cost prohibits their use except in densely built up districts in which either the load in individual buildings may be subdivided between the phases or in which they may be used in connection with secondary mains. Such districts in American towns are pretty generally occupied by the direct current system, and it is doubtful if this system can be ousted by any alternating system. Moreover, whenever secondary mains are used, feeder regulation is also used, and thus any advantage attaching to three-phase transformers is negatived. In the districts which properly and normally belong to alternating distribution, three-phase transformers are out of the question on account of their cost, and three-phase distribution without such transformers is more difficult to control and regulate than two-phase, inasmuch as it is at once more difficult and more necessary to subdivide the load into three substantially equal parts than into two, and as, at the same time, a modification in the e. m. f. of any one of the three-phase circuits involves considerable change in both of the others.

I do not wish to be considered a partisan of the two-phase or an enemy of the three-phase system. In common with most American engineers, I use one or the other, or both, according to the conditions met with in each case, and with all due respect to Mr. Blondel's prophetic powers, I think this will continue to be the practice.

PITTSFIELD, MASS. JOHN F. KELLY.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Open Circuit Windings for Rotary Phase Machines.—OSSANNA.—A long illustrated paper read before the recent Vienna Congress. He discusses a large number of windings which are formed by cutting the usual windings of continuous current machines in certain points, and then connecting the sections in various ways, thus producing open circuit windings, as distinguished from the usual closed circuit windings in continuous current machines. In this way he claims to obtain more favorable conditions for rotary phase currents, than is obtained with the uncut or closed circuit of continuous current windings. With every continuous current winding which in general has $2a$ circuits in parallel, it is possible to cut these in $6a$ points, thus obtaining $6a$ sections, such that similar sections always have the same phase. Six phases will be obtained and the number of circuits represented by a will always have the same phase; there will be 6 groups of a sections each; these sections may be connected in parallel, in series, or grouped in various ways. He discusses three different groups of these windings; the object of the first group is to obtain from a continuous current winding, a three phase current of a different voltage than with the uncut windings; but not all of the windings in this group are new. The second group of windings are specially applicable to rotary phase motors and enable a greater torque to be produced at starting, without the use of a resistance in series with the armature; the greater torque is obtained precisely as with the Goerges winding, in that the voltage is diminished so that there may be a much greater slippage to produce the same torque than with the normal voltage, the current in the wires remaining the same as that when running normally. The third group refers to those windings which can be formed with machines having at least two separate windings, each developing the same voltage. The second group also has the advantage that it is better applicable to producing a braking action. As with most other windings, they are difficult to explain briefly without the numerous diagrams given in the original paper. One of the features of his paper is the graphical method which he develops for showing these windings.—*Zeit. fuer Elek.*, June 25.

Slippage of Induction Motors.—ROSENBERG.—Referring to the method of Hoor for determining such slippage (see Digest, May 27), he gives a modification of it which is specially adapted to non-synchronous motors with short circuited armatures. It consists in the use of a small exploring coil which is held in the magnetic fields and is therefore not excited by the current, as in the Hoor method, but by an alternating magnetic field produced by the magnetic leakage of the armature in the direction of the axis, the period of this field being proportional to the slippage. He discusses and illustrates the origin of such an alternating magnetic field whenever dissymmetry exists in the construction of the armature core or of the windings, and says that such dissymmetry is to be found even in the best constructed armatures. He applied the exploring coil to various parts of the motor and found that the best place to use it is in the neighborhood of an edge, as for instance the edge of a cast iron bearing, surrounding the shaft. He proposes to use a sensitive galvanometer in parallel or in series with the telephone and to make observations simultaneously with the ear and eye, or to use instead of these a registering tachometer in the form of a relay actuating an ordinary Morse writer. In this way a slippage up to 20 per cent. can be represented graphically. The results of experiments are given in tables and diagrams, for a small single phase motor.—*Zeit. fuer Elek.*, June 14.

REFERENCES.

Graphical Study of the Shunt Wound Dynamo and Motor.—DELLA RICCIA.—Starting with the curve connecting the exciting current with the voltage on open circuit, he shows how the ordinary characteristics may be deduced by a graphical construction; also how this graphical method may be applied to the solution of a large number of problems.—*Bull. Ass. Ing. El. Liege*, 9, p. 413; abstracted briefly in *Science Abstracts*, May.

Induction Motor.—POOLE.—An illustrated article describing how to construct a 1-hp two-phase induction motor.—*Power*, July.

Winding Motor Field Coils.—A description of the form used by some Philadelphia traction companies, the advantages of which are that it can be easily taken apart and put together; it is made of iron in two parts, instead of wood.—*St. R'y Jour.*, July.

Alternating Current Fan Motors.—HELDT.—A brief article telling under what conditions it is possible and in what way, to change a fan motor designed for 133 cycles so that it may be run on 60 cycles or vice versa.—*Amer. Elec.*, July.

LIGHTS AND LIGHTING.

Series Alternating Arcs.—A short article comparing the cost of using series alternating current enclosed arcs, in place of the usual continuous current arc light machine driven by an alternating current motor, for use in stations where otherwise only alternating current is generated. A comparison is made between the first cost, the depreciation, maintenance, operating expenses, etc. Supposing a case of 200 arcs, which are being operated by what is called the old system, in which the arc light machine is driven by an alternating current motor, the approximate selling value of that portion of the plant is estimated to be $4,000, and the cost of a plant using the new system to replace it, $6,000; the total efficiency of the two methods

is given as 70 per cent. and 95 per cent. respectively. An estimate shows a saving at the alternating current mains of 80 watts per lamp in favor of the alternating arc for the same candle power. The saving in power alone would be worth about $600 per year. But it is thought that the probabilities are that these figures would about balance, leaving the chief difference between the systems to depend largely on the relative cost of trimming, attendance, etc., and an estimate shows this difference to be about $7 per lamp per year in favor of the alternating arc. The general conclusion is that wherever the old system exists, the alternating arc system will involve a somewhat greater first cost, but that this will be repaid by its greater economy.—*Amer. Elec.*, July.

A Series Alternating Current Arc System.—An illustrated description of the constant current transformers in use on the lines of the Hartford Electric Light Company as mentioned in Prof. Robb's paper before the last electric light convention. The transformers are rated at 100 lights each having two separate and movable secondary coils worked on the series multi-circuit principle with two 50 light circuits. The coils are surrounded by oil and are capable of movement vertically upon the core of the transformer, being mechanically connected so that they balance each other's weight, one going up when the other goes down. A small counterweight is added to force them toward the primary coils and the alternating current repulsion is depended upon to give regulation for various loads. The current is maintained very accurately between 6¼ and 6½ amperes. There are six of these series transformers worked in pairs, the members of each pair being respectively placed across the two phases of the 60-cycle network. The arcs are all of the enclosed type, using 400 actual watts; being in series circuits they need no reactive coils. The article also describes briefly the new hydraulic power station on which the company has commenced work and which will be considerably larger than the present station.—*Amer. Elec.*, July.

REFERENCES.

Differential-Lamp.—GOERGES and QUEISSER.—A paper read before the German Electrical Society. Goerges discusses analytically the superiority of the differential-lamp over the shunt-lamp. Queisser gives a full illustrated description of the new differential-lamp of Siemens & Halske.—*Elek. Zeit.*, June 22.

Street Lighting.—A brief discussion of the choice of the best system for about four hundred to five hundred lamps; the question is whether to use alternating or direct current or rectifiers.—Lond. *Elec. Eng.*, June 16.

POWER.

Gold Mining.—Abstracts of two papers read at the Inst. of Civ. Eng. Hammond's paper on Modern Practice in Gold Mining does not mention electrical applications, but is said to be a very clever compendium of mining geology, mining engineering, metallurgy and mechanical engineering.—Irvine in his Notes on Gold Mining says that the Cornish pump is not suitable, and electrically driven pumps are rapidly replacing it. Their efficiency for moderate lifts may not be as high as that of the Cornish pump, but unlike the latter, it does not decrease with depth, and the cost of installing an electrical plant is much less. As yet, the steam engine for deep hoisting has full possession of the field; but the electric motor should soon begin to displace it. No electrical drill has as yet succeeded in supplanting the air drill and no electrical pump can stand shaft sinking conditions. As to the treatment of slimes, he says that the zinc method is the cheapest, and has, on the whole, proved itself to be the most effectual; but no process has yet satisfied all the conditions of the cyanide method.—Editorially it is remarked that the proof of the precipitation process is in the cleaning-up operation, and up to the present time the electrolytic process has been found the best in this respect.—Lond. *Elec. Rev.*, June 23.

A University Power Station.—A description of the Ohio State University's station at Columbus, Ohio, containing automatically stoked boilers, tandem compound engines and two-phase alternators, one of which is direct coupled. Tests on the boilers and engines show that from 6 to 8 lbs. of water were evaporated per pound of coal and that from 9½ to 11 lbs. was the equivalent evaporization from and at 212° per pound of dry combustible. The engine tests showed a consumption of 30 pounds of steam per electrical horse power output, including that used by the condenser at both 126 and 107 electrical horse power output. With an output of 73 electrical horse power the consumption was 37.4 lbs.—*Amer. Elec.*, July.

REFERENCES.

Porto Rico.—WILSON.—An article on the future engineering development of Porto Rico with special reference to the fine water powers which exist on the island. There are rivers of considerable size falling 500 to 1,500 feet in a length of a few miles. These powers might be utilized by electric transmission for running sugar mills, electric railways, lighting, etc. Up to the present time practically no engineering work has been done on that island.—*Eng. Mag.*, July.

Electricity in Cotton Mills.—S. D. GREENE.—An abstract of his recent paper discussing the influence of motive power on the design of cotton mills. It is claimed that under certain conditions the advance in the manner of transmitting power electrically has made it possible to exercise much greater freedom in designing and organizing the modern cotton mill.—*Cassier's Mag.*, July.

TRACTION.

Electrical Canal Boat Towing.—A report of some researches made by Siemens & Halske, on the Finow Canal, Germany. They first tried the Lamb system, used on the Erie Canal, and then the locomotive system devised by Koettgen in which an electric locomotive fed from an overhead line, runs on the tow path. It was found unnecessary to use a rack and pinion, as a single rail was found sufficient, the other wheels running on the road itself. A locomotive weighing four tons was able to draw 1,000 tons at a speed of 5 km per hour. If a resistance in the water of 300 kg is assumed for the first boat and of 150 kg for every following one of 150 tons, the locomotive would be able to tow at least four or five boats. By the use of electricity, the cost of boat-towing can be diminished about 20 per cent. for this canal, and about 40 to 50 per cent. for canals with a large traffic.—*Elek. Anz.*, June 25, and *Elek. Zeit.*, June 29.

Kingston, Jamaica.—RAYMOND.—A description of the new electric railway in Kingston which is driven by a waterfall twenty-one miles distant from the city. The whole installation is of the most recent type and highest grade, the dam being of concrete, the pipe line of ¼-inch steel 8 ft. in diameter and 6240 ft. long, and the power house built entirely of steel and concrete, raised on stilt like foundations of steel columns to maintain it above freshet level as it stands directly in the bed of the river. Two 400 h. p. wheels are direct coupled to three-phase generators which supply the line through step-up transformers. The current is transformed at the substation through rotary converters which feed the trolley lines. The frequency is 40 cycles per second. Seventeen cars are run regularly on the city lines, which consist of six miles of double track and thirteen miles of single track laid with 90-lb. steel girder rails on steel channel-bar ties bedded in concrete.—*Amer. Elec.*, July.

Germany.—Some notes on electric traction in Germany. A mountain railway 8-7-km long was recently started in the Vosges mountains and a long-distance railway is proposed between Halle and Leipzig. According to two decisions of the highest courts in Germany, theft of electric power is not punishable, as larceny is described as a theft of a movable tangible object. There are 80 incorporated companies engaged in the electrical industry in Germany, 36 of which are manufacturing and 44 exploiting and operating companies; 69 have been organized since 1890; when fully occupied the manufacturers could turn out product to the value of $75,000,000 per year, and as this is more than the home consumption, they must rely on export. At a recent meeting of railway managers it was decided advisable to install motors of large capacity on the cars; switches were also considered preferable to transfer tables for handling cars in the barns. A new and stringent law concerning the protection of telephone wires against induction and leakage from railway wires was proposed. Gas motors tried on several railways have proved to be unsatisfactory and are being replaced by electric motors.—*St. R'y Jour.*, Int. Ed., July.

Overhead Line Construction.—HERRICK.—In this second article of his series, he discusses the insulation of feeder wires. Porcelain, glass and compounds of mica and shellac, rubber and asbestos are generally used. To determine whether the porcelain is sufficiently vitrified, break the insulator, apply anilin ink and then wash; if there is decoloration the porcelain has not been properly fired. A method of testing the strength of insulators is described and illustrated. He points out the objections of a deficiency in copper and gives a table and diagram showing the watts per ton and per mile per hour for various grades and traction coefficients.—*St. R'y Jour.*, July.

Electric Traction.—ROBINSON.—An abstract of a paper read before the Institution of Civil Engineers at Cleveland, England, describing

several roads of which he is manager. Among the interesting features are the methods of complying with the legal requirements which limit the drop in the return circuit to 7 volts. The descriptions include roads in Bristol, Dublin, Middlesborough and the road of the London United Tramway Co.; in the former a booster is used, in the second and third three-phase transmission is used and also a storage battery; in the latter line a three-wire system will be used on account of the requirements concerning the protection of the Kew Observatory, which is near the lines.—*St. R'y Jour.*, July.

Automobiles.—ASHER.—A communication on the methods of charging carriage batteries. In country places where there are no electric power stations, he proposes to use the carriage motor as a dynamo for charging the storage battery, either by the usual endless tread power, which is the best way of utilizing the energy of animals, or by small kerosene or gasoline engines.—*Can. Elec. News*, June.

REFERENCES.

Combined Alternating and Continuous Current Traction Systems.—EICHBERG.—A long, illustrated paper read before the Electrical Congress in Vienna, on the different systems of using combined currents for traction. He discusses those in which alternating or continuous currents alone are supplied to the cars and then gives a very long, illustrated description and detailed discussion of the Deri system, in which the same overhead wire supplies simultaneously continuous and alternating currents, to the specially devised motors on the cars. The action of these motors is discussed and illustrated by a series of figures. Only stationary batteries of accumulators are used. The combination of an alternating and a continuous current in the same line, is discussed analytically.—*Zeit. fuer Elek.*, June 14.

Traction Formulas.—BLONDEL.—He claims that the equations of motion usually given for electric traction, are incorrect, and substitutes a new formula.—*Comptes Rendus*, June 12, abstracted briefly with the equation in Lond. *Elec.*, June 30.

Electrolysis of Gas and Water Pipes.—THOROLD.—An abstract of a paper on the damage to gas and water pipes by the return railway current and on the well known possible remedies.—*Can. Elec. News*, June.

Short articles on the same subject are also given in the *Prog. Age*, July, and *Sc. Am. Sup.*, July 8. They seem to contain nothing new.

Duesseldorf-Krefeld.—BRAUN.—A long illustrated description of this electric tramway. The distance is fourteen miles; the speed required is 26 miles per hour, but velocities up to 37 miles per hour can be easily reached.—*Elec. Zeit.*, June 22.

Paris.—A long illustrated description of the Metropolitan underground railway of Paris, now under construction. It will be operated electrically.—*Sc. Amer. Sup.*, July 1.

Chicago.—A short illustrated description of the power station of the Northwestern Elevated Railway. The special feature is a condenser of a new type which condenses the steam for all the engines together, a system which is said to be more efficient and economical.—*St. R'y Jour.*, July.

Cincinnati, Newport & Covington Railway.—An illustrated description. The capacity is 4000-hp. An illustration shows a hydraulic jack for lifting armatures out of motors; it is mounted on wheels; another shows a novel machine for making armature coils.—*St. R'y Jour.*, July.

Wilmington-Chester.—A brief description of this recently opened railway.—*St. R'y Jour.*, July.

Connecticut.—A map showing the routes of eight electric railways in that city with the population served and a table of the earnings per mile.—*St. R'y Jour.*, July.

Perth.—A short description of the tramway line in this city in Western Australia.—*St. R'y Jour.*, July.

Sao Paulo.—Plans for the new electric railway in this city in Brazil. The road is being built by Americans.—*St. R'y Jour.*, July.

Surface Contact System at Tours.—A brief illustrated description of this system which has already been referred to in the Digest.—*St. R'y Jour.*, July.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Control of Alternating Current Frequency.—ZENNECK.—He has devised a method for controlling the alternating current frequency very exactly, which appears to be decidedly superior, both in sensitiveness and graphic qualities, to the acoustical method of beats. The alternate current is made to produce a rotary field and the cathode beam of a Braun tube is exposed to this field, its end being thus made to describe a circle. "The circle is interrupted twice at every revolution in such a manner as to leave only two dots at the ends of a diameter." This is done by means of a tuning-fork tuned to unison with the supposed frequency, or at least to a multiple of it. While the frequency remains the same, the dots always appear in the same place, but as soon as it changes, the dots advance in one direction or the other along the circumference of the circle. A difference of 0.1 per cent. makes the spots travel round the circle in 10 sec., which is easily observed.—*Wied. Ann.*, 1899, No. 6, abstracted briefly in Lond. *Elec.*, June 30.

Determining the Proper Price for Alternating Currents.—BENISCHKE.—A reprint of a paper read at the annual meeting of the German Union of Elec. Eng. The cost of the power produced is the sum of the cost of operation and of the amortization; but in alternating current plants the price thus determined is not quite correct, if it is assumed to be proportional to the effective power, as it depends on the power factor. Moreover, the first cost includes machines of greater power than is required, owing to this power factor, as the safe limit of a machine depends on the maximum permissible current and not on the power; the transformers and line must also be proportioned for the higher power; if for instance the power factor is X 0.8, the cross-section of the copper for the line must be 25 per cent. greater than for the same effective power when the power factor is unity. Therefore neither the cost of operation nor the amortization are correctly calculated if they are assumed to be proportional to the effective power. For this reason he proposes that the consumer pays for a proper percentage of the wattless current, and that the price for the unit of power be lessened somewhat. An apparatus might easily be devised for registering the proper price of the power, as a wattmeter can easily be modified so that a certain percentage of the apparent watts is registered as effective watts. A numerical example is given.—*Elek. Zeit.*, June 29.

WIRES, WIRING AND CONDUITS.

Application of the Vector Diagram to Long Lines.—BREISIG.—The conclusion of his long serial (see Digest, July 8). He applies the methods to the data of the Lauffan-Frankfort transmission plant and to a determination of the commercial limit of the voltage. He seems to show that it is not advisable to exceed 8000 volts at the end of the line for very long distances, and with present apparatus; in going beyond this the desired gain is not in proportion to the difficulties combined with the use of high voltages (this does not appear to agree with American practice). He discusses similarly, lines of medium length up to about 30 miles, in which the insulation resistance becomes of more importance than on long lines on which the capacity effect is much more serious. His conclusions are not in concise form. The connection between the output and the limit of the voltage is given as follows, the output referring to that in each branch: For 25, 50, 100 and 150-kw, the voltage would be 7, 10, 14 and 17 kilovolt, that is, so many thousand volts. An installation using 40,000 volts would be effective only when the energy in each branch is 320-kw, and the insulation resistance was kept permanently at 20 megohms for 1-km. As a rule, even in large transmissions, he considers that 10,000 to 15,000 volts would be sufficient. In his deductions he did not consider the discharging phenomena accompanying very high voltages, and there would therefore be additional losses which he has not considered which would still further reduce the best practical voltage.—*Elek. Zeit.*, June 8 and 15.

Aluminum Telephone Lines.—In consequence of the high price of copper the German Post Office intends to use other materials for the telephone lines now to be erected. Aluminum wires and bimetallic wires (an iron core covered with copper) will be adopted, while for the present nothing but iron wire will be employed for telegraph lines.—*Elek. Zeit.*, noticed briefly in the Lond. *Elec.*, June 30.

REFERENCES.

Rules and Regulations.—The committee appointed by the Union of German electrical engineers to consider a draft set of regulations for Germany for pressures between 250 and 1000 volts (Digest, June 10) recommended in the recent general meeting of the Union, that the definite adoption of the proposed rules should be postponed. Some alterations in the detail may be necessary, which will be made by the committee during the next two months. The rules will then be issued tentatively for a time, as suggested rules and not regulations, as was done with those for high-pressure.—*Elek. Zeit.*, June 22.

Rules and Regulations.—A reprint in full of the numerous rules

and regulations for light and power installations, in Austria, proposed by the committee of the Electrical Society of Vienna.—*Zeit. fuer Elek.*, June 14.

Interior Wiring.—BATHURST.—A long communication forming part of the long discussion on electric piping which has appeared in that journal. It is in the form of a reply to previous discussions.—Lond. *Elec. Rev.*, June 30.

Calculating the Size of Cables.—Brief discussions of a practical nature, on the best practical method of calculating the size of transmission cables for three-phase currents, given the maximum percentage lost.—Lond. *Elec. Eng.*, June 23.

ELECTRO-PHYSICS AND MAGNETISM.

High-frequency Point Discharges.—HIMSTEDT.—He formerly found that if one pole of a Tesla transformer is connected with a point, and the other with a disc placed at such a distance that no spark is able to pass from one to the other, the disc is charged positively in air or oxygen, and negatively in all other gases, this result being independent of the direction of the primary current in the coil, or of the connection of the poles. Further investigations led to very contradictory results due to the following circumstance hitherto unobserved. He found that the disc is charged positively, negatively, or not at all, according to the distance between the point and the disc. To explain this, the author assumes that a fine point attached to the pole of a Tesla transformer gives out a greater quantity of positive electricity than negative, and further that the negative electricity is capable of being propagated to a greater distance through air than positive electricity. These rules characterize the discharges no matter what may be the nature of the gas, the only difference being that the transition takes place at different distances in different gases.—*Wied. Ann.*, 1899, No. 6, abstracted briefly in Lond. *Elec.*, June 30.

Pressure of Radiation.—DONLE.—He determined the pressure to which the vanes of a radiometer are subjected owing to the radiation which impinges upon them. By means of a bipolar balance he obtained 7x10.5 dynes per sy. cm. for a Hefner candle, 12x10.5 for a stearine candle, 75x10.5 for an Argand burner and 45x10.5 for a Welsbach burner. In an experiment performed to find whether Roentgen rays produce any such pressure, slight indications of pressure were obtained, but nothing definite could be concluded from them.—*Wied. Ann.*, 1899, No. 6, abstracted briefly in Lond. *Elec.*, June 30.

Electric Waves in Air.—MACLEAN.—A long account of the investigation of the velocity of electric waves in air. He used a modification of the method of Sarasin and de la Rive. The oscillator and resonator were tuned with a special form of self-induction. The form and size of the oscillator and resonator, as also the dimensions of their self-inductions and capacities, were identical. The resonator used was a specially devised coherer, like an electrobolometer. The velocity of the electric waves was found to be 2.998 multiplied by ten to the tenth power c. m. per second.—*Amer. Jour. of Sc.*, July.

Hysteresis of Cobalt.—FLEMING, ASHTON and TOMLINSON.—An abstract of a Physical Society paper, describing tests, with a circular ring of cobalt. The results were compared with a similar set of readings taken on a cast-iron ring. A chemical analysis of the cobalt showed that it contained about 1 per cent. of iron and 1 per cent. of nickel. They conclude that, although in general form the magnetization curve for cobalt resembles that of cast-iron, its hysteresis exponent is similar to that of annealed soft iron. The absolute hysteresis values corresponding to various maximum flux densities are, however, not very different from those of a typical variety of cast-iron. In the discussion Blakesley said that the hysteresis curves obtained from the step-by-step method could not be applied to dynamos, because the time taken to perform the cycle altered the shape of the curve; he would like to see the curves for cobalt determined in cases where the cycles were quickly executed. Lond. *Elec.* and Lond. *Elec. Eng.*, June 30.

REFERENCES.

Resistance of Lead Amalgams.—GRESSMAN.—A description of the first of his series of researches to determine the temperature coefficient for the resistance of some lead amalgams, and to measure the freezing points by means of the sudden decrease in the resistance. Amalgams containing from 4 to 25 per cent. of lead were used; they all had a smaller temperature coefficient than mercury; in those containing much lead it was very small.—*Phys. Rec.*, July.

Radiations in a Magnetic Field.—SHEDD.—The first part of a very extended study with the interferometer, beginning with a historical summary.—*Phys. Rev.*, July.

Residual Luminosity of Vacuum Tubes.—SANDRUCCI.—The cathode continues to emit cathode rays for some time after the exciting action has ceased; this phenomena he discusses.—*Nuovo Cimento*, March; abstracted briefly in Lond. *Elec.*, June 23.

Vacuum Tubes with Magnetized Electrodes.—PHILLIPS.—Descriptions of experiments in which the tubes were placed between a large electromagnet.—*Roy. Soc. Proc.*, 64, p. 172; abstracted briefly in *Science Abstracts*, May.

Reflection of Cathode Rays.—SWINTON.—Descriptions of experiments. They support the view that Röntgen rays are due to the charges carried by the cathode particles being imparted to the anticathode reflector.—*Roy. Soc. Proc.*, 64, p. 377; noticed briefly in *Science Abstracts*, May.

Atmospheric Potential.—SEMMOLA.—He discusses the influence of earth-air electric currents and of those traversing the rarefied strata of the atmosphere, causing a decrease of potential with the altitude.—*Nuovo Cimento*, March; abstracted briefly in Lond *Elec.*, June 23.

Polarization.—ANTHONY.—He studied the polarization of simple cells and arrived at the conclusion that the high initial voltage of a cell is due to dissolved oxygen, the negative plate being therefore an oxygen plate. The polarization is not due to hydrogen but to the exhaustion of the oxygen in the electrolyte.—*Amer. Asso. Proc.*, 47, p. 138; noticed briefly in *Science Abstracts*, May.

Radiant Forces.—An article on the forces radiated throughout space from induction coils, and their discharges in vacuum tubes. He gives some results obtained by experiments, but does not seem to have found anything new of importance.—*Elec. Rev.*, June 28.

Hertzian Waves.—DE FOREST.—A theoretical and experimental discussion of the reflection of Hertzian waves at the ends of parallel wires, as used in the Lecher system.—*Am. Jour. of Sc.*, July.

Terrestrial Magnetism.—The following articles are contained in the June number of *Terrestrial Magnetism*. The Beginnings of Magnetic Observations, by Hellman; a translation from the German giving the early history of magnetic observations. A short article in French on the Magnetic Chart of Sicily, by Palazzo. A long article on the Magnetic Work of the U. S. Coast and Geodetic Survey, by Bauer. An article in German on Some Problems in the Earth's Magnetism and on the Importance of International Organization, by Eschenhagen. An article on the Secondary Magnetic Field of the Earth, by Ruecker, being an expanded account of part of his recent lecture before the Royal Institution, and discusses the Wilde model which has already been referred to. This is followed by some remarks by Bauer. There are short biographical sketches with portraits of Charles A. Schott and John Locke. A table compiled by Chree on the mean values for specified years of the magnetic elements of various observatories. Some notes on magnetic observations in the Philippines, a note on the Harmonic Analysis of the Magnetic Variations, by Wilczynski.—*Terres. Magnetism*, June.

ELECTRO-CHEMISTRY AND BATTERIES.

Current in a Liquid Without Electrodes.—KORDA.—A communication questioning the difference between Trouton's electrodeless electrolysis (See Digest, July 15), and the phenomena in the Caldwell interrupter. He describes an experiment which he devised four years ago, by which a continuous current could be produced in a liquid mass, without electrodes, as follows: In a unipolar magnetic field, formed by means of cylindrical and concentric pieces with vertical axes, and covered by an insulating layer on the side of the annular air space, one can pass at a great speed a cylindrical sheet of an electrolyte of annular section. At a suitable speed the induced e. m. f. will equal, or even surpass, that necessary for the electrolytic dissociation of the liquid in movement, and currents will be induced in the liquid by the motion.—Lond. *Elec.* and Lond. *Elec. Rev.*, June 30.

Polarization Capacity of Reversible Electrodes.—ELSA NEUMANN.—An electrolytic cell in a wire of a Wheatstone bridge does not act like an ordinary resistance, but like a resistance in series with a capacity. This polarization capacity has features essentially different from those of an ordinary condenser. If the cell is formed of metallic electrodes in nitrate or sulphate of the same metal, the value of the polarization capacity can be calculated from Nernst's formula. If this capacity is compensated by an inductive reactance in the same wire, the resistance is apparently increased and the current is displaced in phase. The values of these quantities can also be calculated.—*Wied. Ann.*, 67, No. 3; abstracted in *Elek. Zeit.*, June 22.

Jeanty Primary Battery.—An illustrated description of a primary cell of large capacity for which great economy is claimed. It is an improved form of Daniel cell and consists of a wooden tank into one end of which is placed another smaller tank containing crystals of copper sulphate and connected by a series of glass tubes with numerous horizontal copper lined channels. Strips of zinc are placed between these troughs with their lengths horizontal and their widths vertical, the whole cell being low and flat; they are all connected in multiple, as are also the copper linings of the small troughs. Zinc sulphate is poured into the cell, and the troughs will then be gradually filled with the copper sulphate solution to near their top. There is no porous partition, no superposition of liquids of different densities, the products are consumed in proportion to the theoretical quantities, the copper deposit is easily recovered and there is no crystallization or creeping of salts. The cost of the current is said to be only 30 cents per kw hour. The voltage is not given, but it is evidently about one volt. Tables of the consumption of the material are given.—*Cosmos,* May 27; translated in *Sc. Am. Sup.,* June 24.

REFERENCES.

Primary Battery.—DARLING.—A paper describing in detail with the aid of illustrations, the Harrison cell, brief descriptions of which have already appeared in the *Elec. World and Eng.* It is a zinc and peroxide of lead cell, using sulphuric acid; its voltage is exceptionally high, 2.45, which is one of its chief advantages; it may also be recharged when exhausted, like an accumulator.—*Jour. of Frank. Inst.,* July.

Depositions of Copper.—RONCO.—Details of the improved method of Becker. A cathode of copper is prepared with a burnished coat of silver on both sides; it seems that the copper is then deposited on this, a thin sheet being obtained which is covered on one side with an adhesive coating of very brilliant silver.—*L'Ind. Electrochim.,* 2, p. 92; abstracted briefly in *Science Abstracts,* May.

Electrodeposition of Copper from the Sulphate.—FOERSTER and LIEDEL.—A translation in abstract of the article noticed in the Digest, June 17.—Lond. *Elec.,* June 23.

Electrolytic Formation of Alums.—HOWE and O'NEAL.—They describe the preparation of alums containing iron, cobalt and chromium by the electrolysis of metallic sulphates.—*Chem. News,* 78, p. 236; noticed briefly in Science Abstracts, May.

E. M. F. Between Amalgams.—CADY.—A verfication of the conclusions that the e. m. f. of amalgam cells is independent of the solvent and concentration of the solute, but varies inversely as the valency of the metal in the electrolyte.—*Jour. Phys. Chem.,* 2, p. 551; abstracted briefly in *Science Abstracts,* May.

Reversible Electrodes.—NEUMANN.—A theoretical and experimental investigation of the polarization capacity of electrodes immersed in a very dilute solution of their own salt, a more concentrated one being inserted between the electrodes.—*Wied. Ann.,* 67, p. 500; abstracted briefly in *Science Abstracts,* May.

Unpolarizable Electrodes.—WARBURG.—He calculates the polarization capacities of certain unpolarizable electrodes such as mercury in sulphuric acid saturated with mercuric sulphate.—*Wied. Ann.,* 67, p. 493; abstracted briefly in *Science Abstracts,* May.

Drop Electrodes.—MEYER.—Descriptions with a fine jet of mercury falling through various salt solutions.—*Wied. Ann.,* 67, p. 433; noticed briefly in *Science Abstracts,* May.

Efficiency of Electrolytic Processes.—MORITZ.—A short description of his theory of electrolytic dissociation; the energy relations are not discussed.—*L'Ind. Electrochim.,* 2, p. 49; noticed briefly in *Science Abstracts,* May.

Liquid Cells and Ionization of Fused Salts.—GORDON.—He determined the e. m. f. of liquid cells consisting of silver electrodes dipping into solutions of different concentrations of fused silver nitrate.—*Amer. Acad. Proc.,* 33, p. 59; noticed briefly in *Science Abstracts,* May.

Ionic Migration in Dilute Solutions.—BEIN.—A complete discussion of the source of error in determinations of the relative velocities of ions.—*Zeit. Phys. Chem.,* 27, p. 1; abstracted in *Science Abstracts,* May.

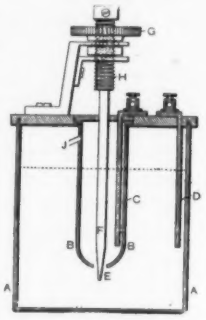
Heat of Solutions.—VAN LAAR and NOYES.—A continuation of the discussion on the heat of solutions, ionization and solubility of electrolytes.—*Zeit. Phys. Chem.,* 27 and 28; noticed briefly in *Science Abstracts,* May.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Wehnelt Interrupter.—WEHNELT.—An account of his new series of researches. From the abstract from which this is taken, it seems that his theory is similar to the one given by Simon in the Digest, July 15. The effect of the self-induction is discussed. Platinum was found to be the best material for the anode; for very large currents several wires can be connected in parallel; dilute sulphuric acid is the best electrolyte. To prevent too great heating of the electrolyte, a cooling apparatus is required. The loss of energy in the interrupter was from 30 to 80 degrees, depending on the self-induction, the current and the voltage. The frequency decreases as the atmospheric pressure increases. He also describes experiments with an apparatus in which the platinum wire is in a glass tube having a hole through one side, thus forming a modification of the Caldwell interrupter.—*Wied. Ann.,* No. 6; abstracted in *Elek. Anz.,* June 29.

RUHMER.—Another account of some experiments. In general his theory is like those usually given. As the production and condensation of the gases at the electrode are of great importance in the action of the break, the interruptions must cease if the electrolyte is heated to its boiling point, which is about 102° C., for the 10 per cent. acid solution, as there is then no more cold liquid for condensation. For temperatures below about 95° C., this can be neglected and the following laws may then be given: as the formation of the gases is facilitated by increasing the temperature at a constant pressure or by decreasing the pressure at a constant temperature, the frequency increases and the mean intensity of the current decreases, in both cases. He found this to agree with his experiments.—*Elek. Zeit.,* June 29.

Liquid Interrupter for Ruhmkorff Coils.—SWINTON.—A modification of the Wehnelt and Caldwell interrupters, especially adapted for use with Ruhmkorff coils. It is capable of easy adjustment to suit different sizes of coils, different voltages, and to take more or less current, and give discharges of different powers and frequencies. It operates equally well whatever be the direction of the current. The apparatus, as shown, in the adjoining figure, consists of a glass vessel filled with dilute sulphuric acid, into which dips the lead sheet D, which forms one electrode, and also the hollow glass cylinder B, which is also filled with dilute acid and contains the lead sheet C, which forms the second electrode. The glass cylinder B is closed at the bottom, with the exception of a small circular aperture E, about 3 or 4 millimetres in diameter. Through this aperture projects the small end of the conical glass valve F, which by means of the threaded carrier tube H, and milled nut G, can be raised or lowered so as to open the aperture to any desired extent. While in operation, the level of the liquid is found tc rise rapidly in the inner cylinder, and an overflow is therefore provided at J. Like all electrolytic interrupters, it will only operate with an inductive circuit, the amount of the self-induction being one of the factors, while the applied voltage is another of those which determine the frequency. With this interrupter and a 10 in. Ruhmkorff coil connected directly to the 100 volt mains (either continuous or alternating) it was found possible by simply altering the adjustment of the valve, to vary the primary current from 0 to 25 amperes, and also to obtain great variation in the frequency.—Lond. *Elec.,* June 30; abstracted in Lond. *Elec. Rev.,* June 30.



LIQUID INTERRUPTER.

REFERENCES.

Electrical Measurements.—ROWLAND and PENNIMAN.—A long account of a series of experiments to test their methods for measuring and comparing self-inductance, mutual inductance and capacity. The apparatus used are described, and the sources of errors and experimental difficulties are mentioned. The following methods are discussed: a method of equal deflections for the determination of self-inductance or capacity in terms of electromagnetic units; a method for the direct measurement of the effect of electric absorption in terms of resistance; a zero method for the comparison of two self-inductances; a zero method for the comparison of self-inductance with capacity.—*Am. Jour. of Sc.,* July.

Galvanometer.—FERY.—For galvanometers of movable coils and of great sensitiveness he suggests reading the angular velocity of the movable coil instead of the deflection, and he shows how such observations can be used for very exact determinations of currents. He proved the complete proportionality between velocity and current for velocities varying from 6-mm to 6-cm per minute.—*Comptes Rendus,* June 5; abstracted briefly in Lond. *Elec.,* June 23.

Frequency Meter.—A brief description of what is claimed to be a simple, accurate and easily made instrument.—Lond. *Elec. Eng.*, June 23.

Kew Observatory.—The annual report of the committee, referring to the national physical laboratory.—*Proc. Roy. Soc.*, No. 413, abstracted briefly in Lond. *Elec.*, June 9.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Wireless Telegraphy.—HAMILTON.—An illustrated paper read before the Council of the Board of Trade, Halifax, on the application of wireless telegraphy to maritime purposes, especially to prevent shipping disasters near the coast of Nova Scotia. He proposes to establish stations at suitable points alone the shore.—*Can. Elec. News,*

Wireless Telegraphy.—GREEN.—A description of the apparatus with diagrams showing the connections of the circuits and an account of the experiments carried on by the writer at Notre Dame, Indiana, and Chicago.—*Amer. Elec.*, July.

Wireless Telegraphy for Navigation.—CLARKE.—A short note suggesting means of detecting the presence of a ship or an iceberg by wireless telegraphy. The apparatus which he proposes is so arranged that when two ships approach each other a large vibrating gong will ring in each, and the transmitter is so arranged that the signal would be operated at a distance of from one to two miles. It could be carried out at small cost.—*Jour. Frank. Inst.*, June.

Municipalization of the Telephone.—MOUNTAIN.—A Municipal Electrical Association paper in favor of municipalization, including the discussion.—Lond. *Elec.*, June 23. A brief criticism appears in the Lond. *Elec.*, June 23.

Vienna.—WEHRENALP.—A very long paper read before the Electrical Congress in Vienna, in which he gives a description of the two new telephone central stations in Vienna. Two large colored diagrams are given.—*Zeit. fuer Elek.*, June 14.

Telephony in Austria.—An article from official sources giving data, maps, diagrams, etc.—*Zeit. fuer Elek.*, June 11.

Sweden.—Some data concerning telephony in Sweden, taken from an annual report.—*L'Elec.*, June 10.

American Telephone Practice.—MILLER.—A continuation of the serial under this title, taking up in this issue the subject of testing, describing and illustrating the methods of testing for grounds and for continuity of wires by means of a battery and receiver, battery and bell or a magneto and bell. Tests as applied to cables before they are placed in the ground, are illustrated.—*Amer. Elec.*, July.

Railroad Signaling.—ROSS.—A short paper read before the Institution of Civil Engineers in which he compares the advantages and disadvantages of uniting the lock and block signaling appliances of railways.—Lond. *Elec. Eng.*, June 23.

MISCELLANEOUS.

Electric Light Bath.—KELLOGG.—An abstract of a paper read before the American Medical Association. He had previously found that the electric light bath stimulates the elimination of carbon dioxide in a very marked degree, that the elimination of nitrogenous wastes, represented by urea, and also the elimination of total solids, was greatest in the Russian bath and least in the electric light bath; that the amount of perspiration produced by the electric light bath was fully double that induced by the Turkish bath in the same length of time, and that the time required for the first appearance of perspiration was in the electric light bath about one-half that in the Turkish and Russian baths. He now believes that there is no specific effect obtainable from the electric light which would not be derived from any equally efficient source of radiant heat. By accomplishing the required results in so short a space of time, the electric light bath is comparatively free from the exhausting effects which often result from the Turkish bath, the hot immersion bath and other modes of inducing perspiration.—*Sc. Amer. Sup.*, July 1.

Printing Telegraph.—A brief description of the Kamm apparatus which is intended to replace the Hughes, and is applicable to telephone lines. The manipulation is claimed to be very simple.—*L'Ind. Elec.*, June 10.

Removing Wool from Hides.—A brief illustrated description of an apparatus consisting essentially of an electric cautery conveniently mounted in a handle. The current required is about 60 amperes at 4 volts; the work is done so quickly that the heat injures neither the hide nor the wool. It is estimated that it is possible to remove all the wool from 8 to 12 skins per hour.—Lond. *Elec.* and *Elec. Rev.*, June 20.

Book Review.

FORTSCHRITTE DER ANGEWANDTEN ELECTROCHEMIE UND DER ACETYLEN INDUSTRIE IM JAHRE, 1898. By Dr. Franz Peters. Stuttgart: Arnold Bergstrasser Verlagsbuchhandlung. 412 pages, 61 illustrations. Price, 6 marks.

This is a year-book, which gives in a very condensed form the substance of patents and published papers from all sources which have appeared during the year, relative to electro-chemistry and the acetylene industry. The abstracts are made by the author mostly without comment, though he has occasionally punctuated with an interrogation mark the most absurd statements. It is to be regretted that in books of this class there is little room for comment, and that the good, bad and indifferent stand on the same footing. Some papers of apparent importance are given only a few words, while others of no value are given considerable space.

Seventy-eight pages are devoted to electric current generators, in which are included both primary and secondary batteries. This portion of the work shows that, while there has been considerable activity in this field during the year, there has been no really substantial improvement recorded either in primary or secondary batteries. It is much chaff with apparently only a grain or two of wheat. Perhaps the most valuable contribution mentioned in this part of the book is that of G. Darrieus, which is a discussion of the chemical changes in accumulators. More than 200 pages are devoted to inorganic electro-chemistry, in which a few pages are given to the metalloids, the most important relating to methods of preparing oxygen, hydrogen and ozone and to the uses and properties of persulphates. The manufacture of carbide and acetylene and of alkali and chlorine have received considerable attention.

The descriptions of the various processes and apparatus seem to have been taken chiefly from patents, rather than from experience. The value of such descriptions is always questionable, except for the purpose of showing the state of the art to inventors; for whom, however, the book serves the purpose of a patent office digest. "A Digest of Patents and Publications" would have been a much more appropriate title. Any book which is a mere compilation, giving no hint or suggestion as to what is reliable and what is fabulous, should be called an index or a digest. In this book the author seems to have entirely avoided responsibilty. This is to be expected in an index of literature, but not in a book claiming to give the progress of a branch of science. In such a book we are naturally disappointed to find without criticism, the absurd claims of every imposter and of the multitude of ignorant inventors.

For example, we find here recorded a description of the "process" of getting gold from sea water invented by the Rev. Mr. Jernegan and used by the "Electrolytic Marine Salts Co." Strange to say, however, the most important part of the process, which was diving in the dark, is not alluded to. Another of these fables is the "process" by which the dome of the Philadelphia City Hall was "aluminum plated"—with tin. This was simply a *process*, by which that quiescent borough without a murmur of complaint handed over to its ever industrious politicians about one hundred thousand dollars and asked no questions. The word "aluminum" was used in the contract as a "blind," the politicians and contractors knowing they would get their money long before the people would discover that they had gotten the *tin* instead of aluminum.

The book contains many references that are equally valueless and allegations that have been refuted years ago and reinvented and patented. Aside from its value as an index, the book is hardly worth reading.

Electric Phonautograph.

BY THOMAS J. MURPHY.

The device illustrated herewith relates to a new system of transmitting intelligence electrically to great distances. The principles involved are as follows: Currents of electricity are sent over the line to actuate signals which are previously understood by the operators to represent lines drawn in definite directions.

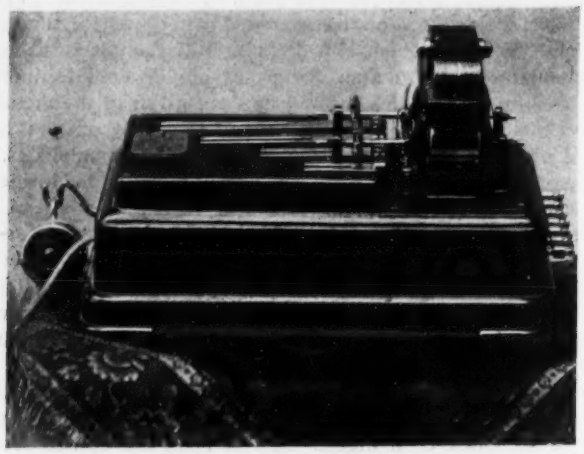
The accompanying cut gives a fair idea of the mechanism involved, which is simple and positive in action. Two line wires are used, but considering the extent to which the instrument adapts itself to multiplex working, this is not a serious objection.

The transmitter is in the form of a stylus or pen, with four sets of contacts arranged at right angles to each other. The inner ones are alternately connected to two sources of electric currents; while

the remaining contacts, suitably fastened and arranged yieldingly in proximity to the former ones, are cross-connected and thence to ground and line. A small vertical rod, swung from its upper extremity, extends downward through the stylus, and is provided at its lower end with a holder for either a pen or pencil. A short distance above this holder a rectangular piece of fibre or other insulating substance is fastened on the rod between the contacts. The function of the rectangular piece is to press against the yielding contacts when the stylus is drawn along the paper in the act of writing.

The receiving portion of the instrument comprises two polarized magnets arranged to actuate hammers which strike sounders tuned to different pitches. Means are also provided to short-circuit the line between the receiver and stylus, thereby leaving the instrument ready for receiving a message from the distant station.

In sending a message, the stylus is used similarly to an ordinary pen. By drawing it along the paper the friction between the former and the latter causes definite contacts to be brought together, thereby allowing either a positive or negative current impulse (dependent upon the direction in which stylus is drawn) to traverse the line (or lines if the stylus is drawn diagonally), and actuate the sounder or sounders corresponding to the direction in which the stylus is



ELECTRIC PHONAUTOGRAPH.

drawn. It is clearly apparent that the line wires are necessary merely at the commencing of a line or for any instant during the drawing of this line; consequently, the number of instruments that could be used simultaneously on the same circuit is evident.

It might be mentioned that if any one of the two line wires should by accident be broken, telegraphic messages could be transmitted by the instrument over the remaining one.

It is quite probable that multiplex working on submarine cables is not beyond the possibilities of the "Phonautograph." One thing is apparent—that errors would be reduced to a minimum by this system. It is also evident that a modified form of shorthand could be used with more or less success, and a codal system reduced to numericals with possible advantage.

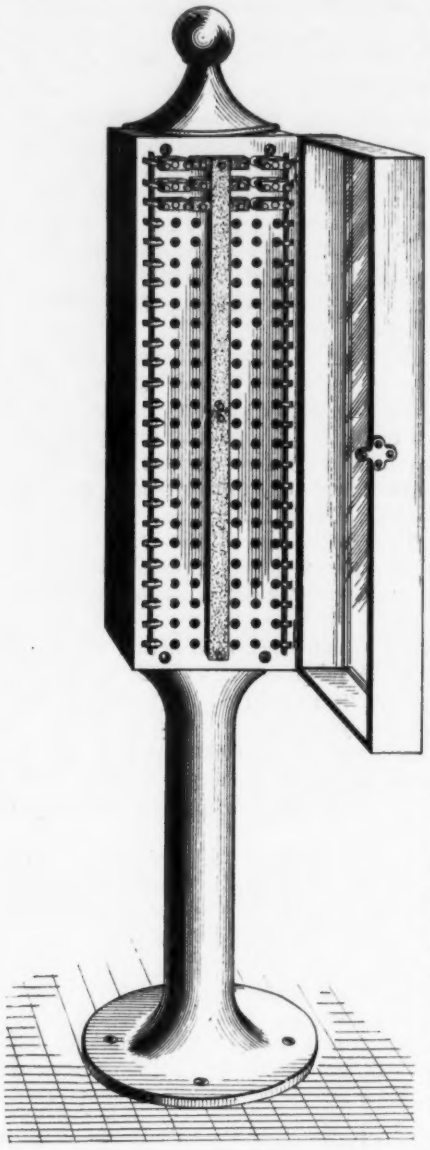
It should be clearly understood that for submarine working a modification of the receiver along the lines of the Thomson reflecting galvanometer would be necessary. This would render the receiving of the message very simple, as the mirrors would swing in synchronism with the transmitting style.

In conclusion I might state that I have made applications for domestic and foreign patents on a "Telautograph," based on the same principles involved in the Phonautograph herein described.

The Rolfe Protector.

The protection of electrical instruments and circuits against the damaging effects of lightning, heavy currents and sneak currents is a subject that demands the most careful consideration in planning an electrical installation.

To obtain adequate and reliable protection many forms of fuse appliances, magnetic cut-outs and similar devices have been designed and tried. Among the most meritorious of these may be mentioned the Rolfe protector, which affords protection by the operation of a heat coil composed of a mass of fusible material and a small coil of high resistance wire embedded in the fusible material. When an abnormal current passes, the heat generated by the high-resistance wire melts or softens the mass of fusible material and causes the circuit to be broken or opened either by effecting the bodily removal, or jumping out, of the heat coil from the circuit or by breaking the high-resistance wire of the coil. In many of both classes of instruments lightning arresters in the form of opposing carbon blocks are added.



CABLE TERMINAL.

In the accompanying illustration is shown a cable terminal made in the form of an upright stand intended for use as a terminal for cables running into telephone exchanges, telegraph offices, fire alarm headquarters, etc. Each line is provided with a removable carbon lightning arrester and a heat coil "jump-out." These terminals are made in three standard sizes, viz.: for 50, 100 and 200 wires, although other sizes can be built to order. Another form of this terminal is made for use at the junction of aerial wires and cable conductors, and upon other outside constructions.

These devices are manufactured by the Rolfe Electric Company, which was recently organized in Chicago, with a capital stock of $50,000. The company intends to manufacture electrical apparatus, and particularly apparatus designed and invented by Charles A. Rolfe, its president. Prominent among the Rolfe devices is the Rolfe protector, above described. This protector has been perfected by Mr. Rolfe after ten years practical experience in this field. Another invention of his, which the company intends to put on the market, is a fire alarm apparatus, which is said to be particularly effective in its operation. The office and factory of the company are at 355 North Wells Street, Chicago.

Electric Heating in a Carmelite Hospice.

In the new hospice building of the Carmelite Fathers on the bluff back of Victoria Free Park, on the Canadian side, are to be found some of the very newest features of the Niagara electrical development. When the entire plan is carried out this new structure will take the place of the little chapel and shrine that was built in the early twenties. In this holy place the Catholics from all over the country and foreign shores have worshiped. In the inspiring grandeur of the great cataract the late Archbishop Lynch, of Toronto, saw an inspiration for religious devotion, and petitioned Pope IX. to grant all the favors and privileges of the European sanctuaries to the little shrine at the Falls, with permission to transfer the privileges to the new shrine when completed. Thus, in the course of time, the shrine and hospice will be combined. Then the shrine will have its place in the center, the wing to the south being set aside as a monastery, while the north wing, to which this article especially refers, will be the home for guests or pilgrims, The present wing forms an "L" 200 by 250 feet, the distance from the ground to the top of the towers being 85 feet. In the front of the building there is an arcade graced with massive granite columns. It is in this building that the Carmelite Fathers

have had the enterprise to install an electrical equipment so that the power of the Falls may be used throughout the structure for light, heat and power.

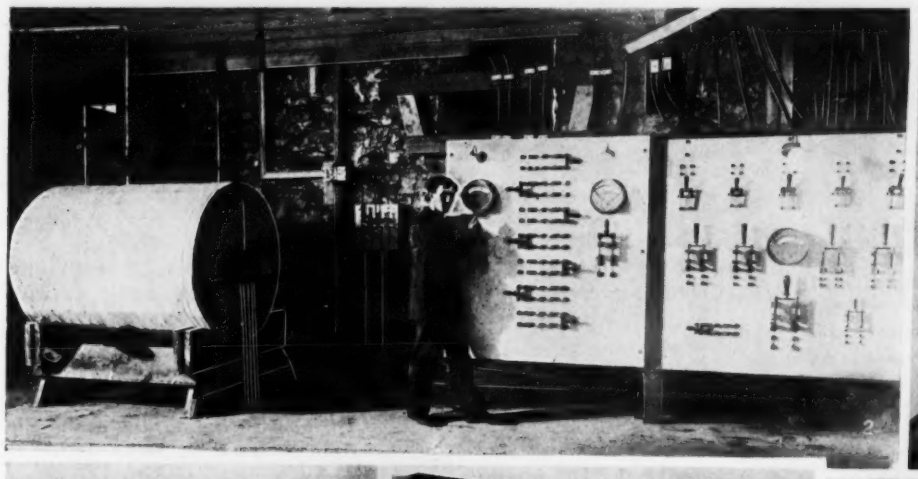
The current used by the Carmelite Fathers is obtained from the Canadian Niagara Power Company. It is generated in the station of the Niagara Falls Park & River Railway, where the Canadian Niagara Power Company has installed a temporary plant pending more elaborate development under its franchise privileges, in order that the Canadian side of the river at the Falls may have all the electrical power called for in factories and other places. The power station is located about two miles from the hospice, and the current is carried over No. 3 bare copper wire strung on a pole line. The transformer house of the hospice plant is a small wooden building located about 150 feet from the main building. It contains two 30-kw Westinghouse and one 25-kw General Electric transformers, primary 2200 volts and three-phase secondary 110 volts, current being transmitted through underground cable to the switchboard in the main building. The switchboards are located in the basement. A switchboard with double-throw switches controls two phase of the current, and the third phase is controlled by a switchboard adjoining the first one, and is used for cooking, lights, etc. The two switchboards are so arranged that either transformer can be used independent of the other for either purpose.

In the hospice building, there are 200 16-cp incandescent lights, the current supply of which is taken from 25-hp used for this purpose, for cooking and for heating water. The total amount of power taken by contract is 100-hp, and the other 75-hp is applied to heating the lower floor of the hospice building, which comprises 11 bedrooms, a dining room, reception room and office, and the corridor. This corridor is 120 feet long, 10 feet wide and 15 feet high. In it are installed nine 4-hp heaters. Each of the bedrooms is 10 by 12 by 15, and in each one there is one 4-hp heater with changeable heat switch of two heats.

The kitchen of the hospice is equipped with an electric combination range and three electric ovens. This range has a heating surface of six square feet, each square foot of surface consuming 15 amperes and having a switch that allows the current to be controlled at full or half heat. Of the three electric ovens two of them are small and one large. Each of the small ovens has three compartments, and consumes 23 amperes of current at 110 volts, while the large oven takes 50 amperes. This oven equipment is so arranged that four 25-pound roasts can be handled at one time.

In the butler's pantry there are electrically operated urns and a chafing dish. The urns are three in number, each of five gallons capacity. One of the urns is used for making tea, one for making coffee, and the other for heating water for use in the tea and coffee urns.

Down in the basement, standing close by the switchboards and in the same room, there are two boilers electrically operated. One of these has a capacity of 400 gallons, while the other has a capacity of 150 gallons. The 400-gallon boiler is used for heating water for laundry and bath room purposes, and takes a current of 120 amperes, being divided in three heats. The small boiler is used for heating water for kitchen use, but can also be used in connection with the large boiler. The small boiler takes 125 amperes, being also divided into three heats. It is used principally for quick boiling. Both of these boilers are covered with 2½-inch asbestos covering. All water is boiled, so far as possible, when current is not being used for other purposes.



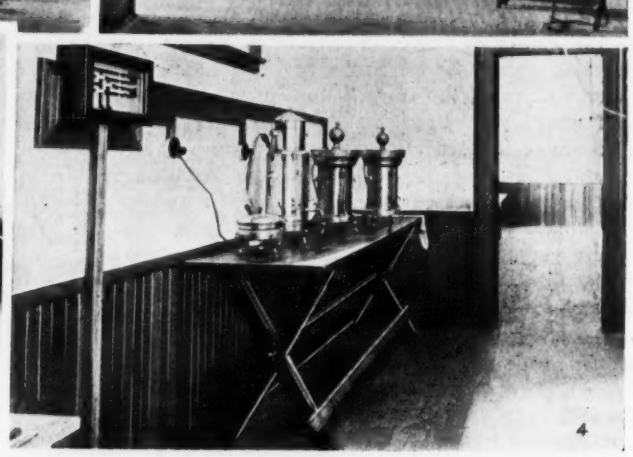


Fig. 2.—Electrically Heated Boiler.
Fig. 5.—Electric Kitchen.

Fig. 3.—Corridors.
Fig. 4.—Butler's Pantry.

ELECTRIC HEATING AND COOKING EQUIPMENT IN CARMELITE HOSPICE.

The electrical kitchen has been found capable of most successful operation, and on June 15, on which day the building was formally blessed by His Grace, the Archbishop of Toronto, the Most Rev. Denis O'Connor, D. D., of Toronto, dinner was cooked for 250 people. This did not include the soups which, owing to their taking hours of time in their manipulation, were prepared in the kitchen the day before. But all meats and other food were cooked electrically that day. In the big boiler it is possible to heat water from 60 degrees to 212 degrees in six hours with full heat. In the small ovens, bread can be baked in 18 minutes. On the door of the big oven there is a barometer which shows the heat and indicates the temperature through the different times of roasting and baking. The heat of the ovens is kept uniform from the start to the finish of the cooking.

The current used for water heating, cooking and lights costs $25 per hp, or $625 a year, while the 75-hp used in heating the corridor and bedrooms is secured at about one-fifth this price per hp. It

is evident that the heating service is not in use only during certain months of the year, and in addition to this the power is obtained from a station where in winter time there is a surplusage, owing to the fact that not as many cars are operated in winter on the scenic line as during the summer time. But one important feature demonstrated to the owners of the plant during the past winter was that a combination fuel and electric hot water heat-

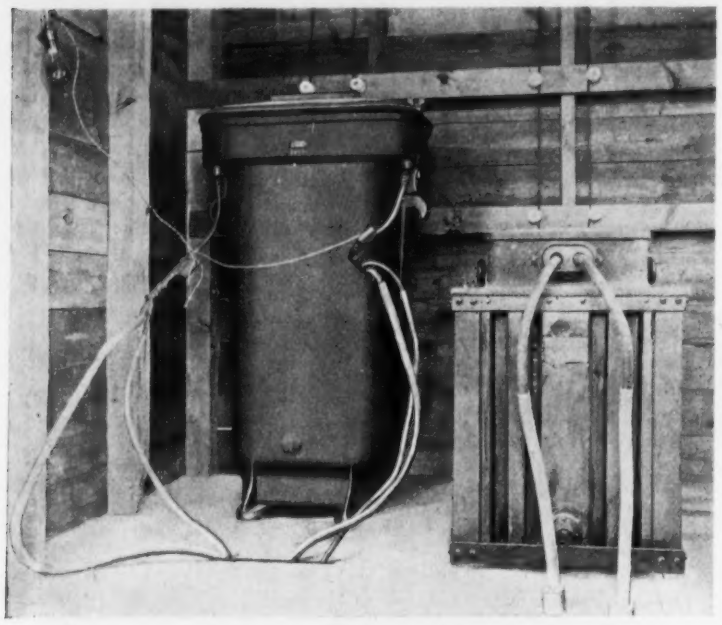


FIG. 1.—TRANSFORMER.

ing installation might be found more serviceable under present conditions than the separate electrical heating installation, for much trouble has been experienced on the Canadian side in winter in the matter of power development from anchor ice, in fact during last winter the ice was very troublesome on both sides of the river. At times the current was entirely cut off, and at such times and under such circumstances a fuel service under the boiler to heat water for general heating purposes would have been deemed ideal. The plant of the hospice was installed by Mr. A. Harth, and he has expressed a belief that such a system of heating would be most advantageous not only at Niagara but in other places where people seek to use electricity for heating purposes, whether in factory or residence. The idea thus expressed is, that instead of carrying the current through the building to heaters located here and there, it might, in many cases, be better to install a hot water heating plant and apply all the current to the boiler for heating the water for circulation through the building, and where the electric service is for any reason likely to be cut off have a fuel service at the boiler ready for immediate operation.

No doubt many other new ideas will be developed at Niagara in the matter of using electricity for heating, but the plant in the hospice has given great satisfaction, and it is the wonder of all who see it. One very noticeable feature of the kitchen is the entire absence of dirt and soot on the various utensils used on the stove or in the ovens. The plant, as a whole, requires but little care for its operation and management.

Special Crocker-Wheeler Motors.

Owing to the present large range of applications of electric motors, special types are springing up to provide for special purposes. To meet the requirements thus involved, the Crocker-Wheeler Company has recently designed several types for mill, shop, elevator and other special work.

For places requiring motors of great starting torque and capable of ready reversal, and protection by enclosure from foreign substances which may be in the air, the type shown in Fig. 1 has been designed and named "Mill" motor from the places in which they were first used. For places requiring motors that can be started automatically without rheostats and yet come up to full speed by a regular rate of increase without depending upon the skill of the operator, a modified form of this type is made by them and known as their "Elevator" type, shown in Fig. 2. For places requiring motors which are called upon to stop suddenly and automatically within any desired degree of precision, they have added a brake to their bipolar machines, the reversing form of which is shown in Fig. 3.

As will be seen, the mill motor type is ironclad, the enclosing metal serving at the same time as the field frame. This type with back gearing is practically the same as electric railway motors which they closely resemble; by omitting the feet and extending both ends of the countershaft so that gears can be mounted on them, these motors are thus made suitable for industrial railways. Except in special cases, the motors are series wound, this being the arrangement best suited for the class of work for which they are designed. The machines may, however, have a compound winding, consisting of very small shunts to give the fields enough strength when the load is thrown off to keep the speed of the machine down to a reasonable limit. Since these motors are used chiefly in work which requires that they be frequently reversed, the brushes cannot have a lead, and are always therefore fixed permanently in a central position. The fields of the machines, however, are made strong to enable them to run in either direction without sparking.

In their operation, these motors when slowing down or starting up are capable of exerting a turning power many times greater than that given at full speed. The efficiency is highest at middle speeds; at starting and at low speeds, it is small, for the reason that the losses are nearly uniform at all speeds and at low speeds comparatively little power is developed though the machine has a strong starting torque. At high speeds the efficiency again falls off, as the

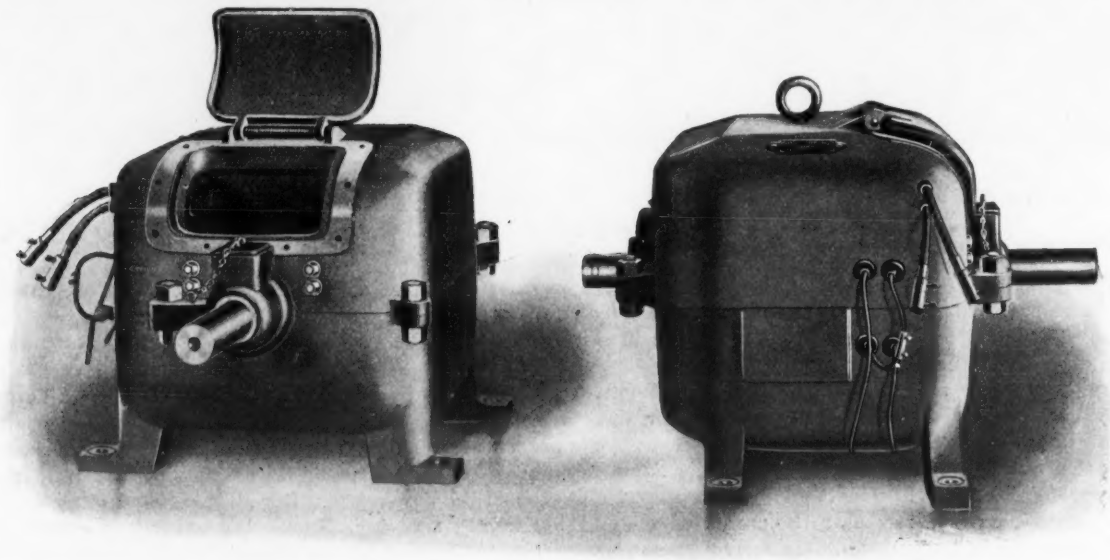


FIG. 1.—MILL MOTOR.

torque is then reduced owing to the light load and the effect of the series winding, so that although the speed may be very high, the product of the torque and speed for the output is not correspondingly high. The speed is high at light load and drops off very rapidly at first and more slowly afterwards as the load increases; the reduction and the change of rate being due to the increase in field strength, which is very great at light loads and less at heavier loads, owing to the field becoming saturated. The torque increases very slowly at first and rapidly with heavy loads, reaching a very high

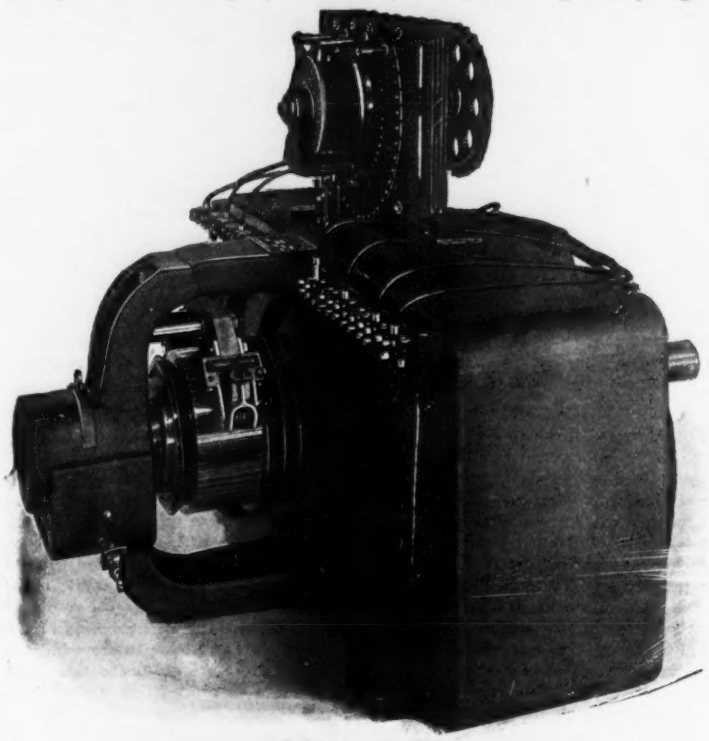


FIG. 2.—ELEVATOR TYPE MOTOR.

point with severe overloads, due to the increased field strength at heavy loads obtained by the series winding.

In enclosed motors there is no ventilation and consequently the rise of temperature is greater than in the case of open motors. As these motors are designed for intermittent work only, the fact that if run continuously at full load they will heat greatly is unimportant, as the limit is seldom reached on account of the character of the work for which they are employed, allowing intervals for cooling. The curves of Fig. 4 illustrate the heating of the machine in intermittent use. One curve shows the rise of temperature for continuous current at full load. Two curves of cooling are shown, one

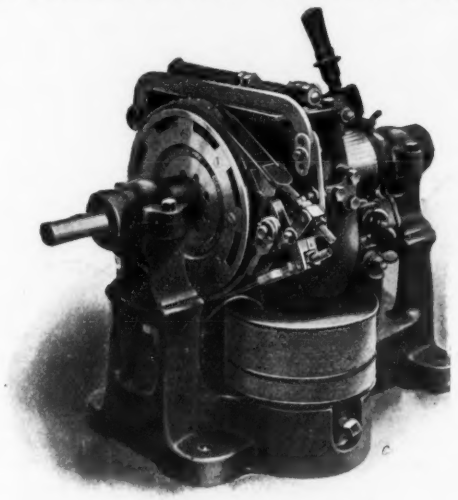


FIG. 3.—REVERSING BRAKE MOTOR.

starting from 50 degrees C. above the atmosphere and the other 10 degrees above the atmosphere. The irregular line shows the effect of successive heating and cooling, one portion corresponding to curves drawn from the temperature at which the machine was started, and the other portion to curves corresponding to rise in temperature.

In the elevator motor shown in Fig. 2, similar lines of design to their mill motor are followed, the same armature employed, but not entirely enclosed. For gradual starting without excessive current, the magnet frame is made of the ordinary box form, extended, however, in order to permit the introduction on the field of additional sections of coils for starting. These coils are so graduated that the first takes very little current, the next a little more, and so on, while all contribute to the working strength of the machine. These coils, properly calculated, enable the motor to be started and brought evenly and quickly to full speed by means of a steadily moving starting switch, without at any time drawing more current than that used at full speed. By this means a sudden inrush of current is avoided at starting, which saves from fluctuation any lamps which may be connected to the circuit nearby. Five series coils are used to obtain gradual starting and in addition there are shunt coils. An elevator motor of this type having a gross weight of 1947 pounds will develop 12-hp in continuous elevator work at a speed of 700 r. p. m., with a temperature rise not exceeding 45 degrees C., and a starting torque, equivalent to that which, at the regular speed, would give 24-hp.

The brake motor shown in Fig. 3 is especially applicable in hoisting and in driving machinery which, like printing presses, has to be stopped with precision. Part of the regular working current of the machine is used for operating the brake at the same time that it energizes the motor fields. One of the pole pieces is pivoted to the base so that it has a slight backward and forward motion toward and from the armature. When the machine is at rest and the field not energized, a heavy coil spring pushes this movable pole piece away from the armature, and tightens a leather-lined band, which grips the brake wheel attached to the spider of the armature. When the current is thrown on, the magnetism of the field draws the movable pole pieces inward, overcoming the force of the coiled spring and causing the brake band to release the brake wheel, thus leaving the armature free to rotate. The action of the brake is thus automatic. The field resumes its normal position when the motor is in operation; no extraneous coil or other mechanism is required, as the brake spring is overcome and the armature released by the attraction of the field.

The spring and brake band are adjustable so that the armature may be allowed a few revolutions in which to slow down before stopping; or it may be stopped and held firmly the instant the current is shut off. In all cases the friction of the brake is greater than the driving power of the motor, so that the brake is able to hold up any load which it is able to handle in operation. The brake mechanism of a reversing brake motor is shown in Fig. 3. It consists of a brake wheel on the armature shaft, and a band and lever, the latter being connected to the pivoted pole piece.

It is pointed out that a size 10 brake motor running at normal speed can be stopped in three seconds while making 30 revolutions and that if it is desired to stop in a shorter time the brake may be adjusted to do so, the amount of energy absorbed being correspondingly greater than in the above example, in which the brake

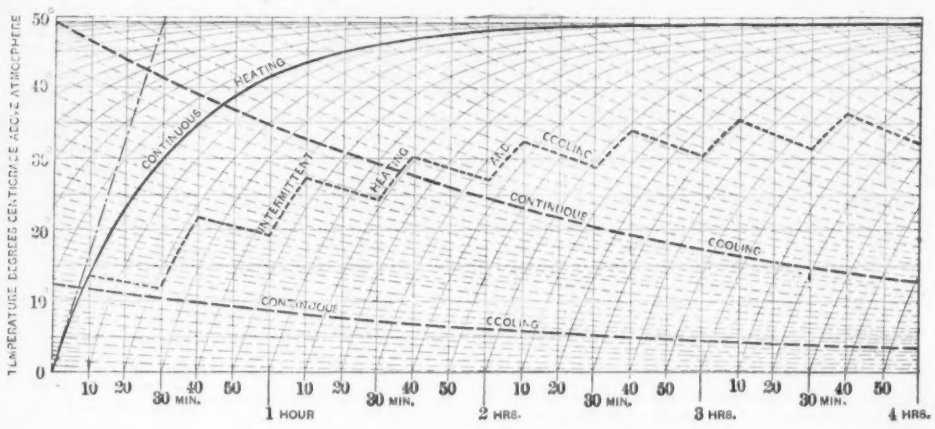


FIG. 4.—HEAT CURVE.

would be set so that it would hold the full load of the motor, that is a load requiring 10-hp to hoist.

The construction of these machines having characteristics for special work is very interesting and their design is a valuable contribution to electrical engineering on account of the technical grounds on which they are based.

NEWS OF THE WEEK.

Financial Intelligence.

PUEBLO (COL.) MORTGAGE.—The Pueblo Traction & Electric Company has filed a $750,000 trust deed in favor of the American Loan & Trust Company. The loan will run twenty years at 5 per cent.

ELECTRIC COMPANY OF AMERICA.—A dividend of 50 cents per share has been declared by Electric Company of America, and a call of $2.50 per share authorized. The dividend is payable July 25, and the call payable Aug. 1, the latter being intended to pay for properties recently acquired.

AMERICAN BELL TELEPHONE.—It is now stated that all the arrangements have been completed for the removal of the American Bell Telephone Company to New York and for consolidation with the American Telephone & Telegraph Company, when the new stock of the company will be listed on the New York Exchange. The old Boston offices are to be occupied by the New England Telephone & Telegraph Company.

NEW ENGLAND TELEPHONE.—The New England Telephone & Telegraph Company has acquired all of the $600,000 capital stock of the Southern Massachusetts Telephone Company on the basis of four shares of New England stock for three shares of Southern Massachusetts. The latter company has operated as a licensee of the American Bell Telephone Company in the five southern counties of Massachusetts, and has about 4000 exchange subscribers and an extended system of toll lines through the larger part of its territory. The company has paid 8 per cent. dividend for several years, while the New England Company has paid at the rate of 6 per cent. The following have been elected directors: Charles F. Ayer, Moses G. Parker, Samuel Ivers, Charles W. Clifford, John E. Hudson, Jasper N. Keller and Thomas Sherwin.

ELECTRIC VEHICLE COMPANY.—Mr. I. L. Rice has announced the placing of orders by this parent company for 4200 automobiles, to be furnished by its affiliated companies. Of these 4200 vehicles about 2000 will be hansoms, broughams, cabs and landaus. About 200 will be delivery wagons, and the others will be passenger vehicles of miscellaneous types, including runabout, daumons, golf traps, victorias, etc. A large amount of the motor work will be done by the Siemens & Halske Company. The batteries will of course be Columbia Chloride. Bodies will be made by the New Haven Carriage Company, and some bought from the Studebaker Company. The factory facilities of the Columbia & Electric Vehicle Company, at Hartford, are being rapidly extended, and a large part of the technical staff has been concentrated there.

SOME TRACTION STOCKS.—Among the out-of-town traction stocks that advanced last week were United Traction of Providence and Worcester Traction common. The strength of the latter, which closed at 29 bid, a net gain of 4½ points, is due to the probability of a dividend being before long declared on that stock. Brokers said to be acting for insiders were the principal bidders for Worcester Traction. United Traction of Providence advanced from 94 to 97, and closed at 96¾ bid, a net gain of 2¾ points. The advance is attributed to excellent reports of the company's business, which shows a very large increase over last year. It is said that the company's earnings for the month of June were $30,000 in excess of the earnings for the same month of last year. For Columbus Street Railway stock 94 was bid without calling out any amount of stock.

THE PHILADELPHIA COMPANY, Pittsburg, has earned $715,000, or 5 per cent., upon its capital stock of $14,475,000 during the first five months of 1899, notwithstanding the fact that the constituent properties have been operated under one management for less than four months of that period. It is estimated that the Philadelphia Company will show earnings of 9 per cent. upon its common stock for the current year. A quarterly dividend of 1½ per cent. on the common stock has just been paid to stockholders of record July 5. This company has a monopoly of the electric lighting as well as the natural and manufactured gas lighting in Pittsburg and Allegheny City, Pa., and owns a controlling interest in the common stock of the United Traction Company of Pittsburg, which company controls the passenger traffic of Pittsburg, Allegheny City and adjacent suburban towns on the Monongahela River.

KINGS COUNTY ELEVATED.—The Kings County Elevated Railroad Company, a reorganization of the Kings County & Fulton Elevated Railway Company of Brooklyn, was incorporated last week by the Secretary of State with a capital of $8,800,000, of which $2,800,000 is preferred stock entitled to a non-cumulative dividend of not more than 5 per cent. per annum, and $6,000,000 common stock. The directors of the new company are E. Mora Davison, Welton C. Percy, Charles H. Warner, George S. Bonner, Walter F. Wood, Adolph Frank and William J. Cahill of Manhattan and John L. Wells and Benedict Hamburger of Brooklyn. The purchase of the Kings County Elevated road by August Belmont, representing the Reorganization Committee, now places the property under the control of the Brooklyn Rapid Transit Company. President Rossiter states that formal possession of the elevated road would be taken about the latter part of this week, and that there would probably be no change in the traffic operations for some time. The present officers and employees will also be continued.

CHICAGO & MILWAUKEE RAILWAY.—A mortgage has been filed by the Chicago & Milwaukee Electric Railway Company, of Chicago, to secure the payment of $1,500,000 of gold bonds, maturing in twenty years, with interest at 5 per cent. The mortgage runs to the Royal Trust Company of Chicago and the Cleveland Trust Company of Cleveland, O. The instrument covers all of the property of the company, real and personal, in the counties of Cook and Lake, and all of the railway of the company now constructed and all to be constructed hereafter in this territory. This includes all branches, sidings, crossings, lands and tenements acquired and to be acquired, and also various property in the township of New Trier. The document was signed for the Chicago & Milwaukee Electric Railway Company by George A. Ball, president, and George M. Seward, secretary; for the Cleveland Trust Company by Amos B. McKairy, vice-president, and for the Royal Trust Company by E. G. Tillotson. These companies are to act as trustees. The bonds bear date of July 1, 1899.

MASSACHUSETTS ELECTRIC COMPANIES.—Earnings continue to show steady increases, those for the first week of July increasing $14,000 or 12½ per cent. General Manager Sullivan is rapidly introducing economies in the operation of the thirty-four constituent companies. It is estimated that the saving in salaries of officials alone will be $52,000 per year, and the saving in the purchase of coal, oil and other supplies $200,000 per year. It is the purpose of the management to begin the payment of dividends on both the preferred and common stocks at the rate of 4 per cent. and 2 per cent., respectively, Dec. 1. The decline in the stock from 93 and 30 to 80 and 25, respectively, for the preferred and common stock has been on comparatively small sales of stock. The interests back of the company have refused to make an artificial market, feeling confident of the strong position of the securities and believing that they will soon be quoted much higher when the intrinsic value is more fully realized. It is said that there are some 1200 stockholders in the company, the holdings of 800 of which will not average over 35 shares.

BUTTE LIGHTING & POWER COMPANY.—The stockholders of the Butte General Electric Company are in receipt of a circular from the Committee of Reorganization requesting assent to a plant involving the exchange of stocks and bonds of the present company into stock and bonds of a new corporation to be known as the Butte Lighting & Power Company. The old company has $600,000 of stock and an authorized issue of $500,000 6 per cent. bonds, together with a floating debt of $150,000. The new company will be formed under New Jersey laws, with a capital stock of $1,000,000 and $750,000 5 per cent. 30-year gold bonds. The property of the present company is to be sold to the new corporation (subject to the bonds) for $1,000,000 stock of the new company. Of the new bonds $500,000 may be used to retire bonds of the old company now outstanding, the remainder to be issued for future additions to property. The committee will exchange $600,000 of stock of the new company, share for share, for the stock of the Butte General Electric Company. An effort will be made to sell the remaining $400,000 of new stock for $200,000 cash, which amount will be used to retire floating debt of old company and for benefit of the new. Each stockholder of the old company is offered the right to subscribe for one share of the new stock at $50 per share for one and a half shares of stock of Butte General Electric Company held.

WEEK IN WALL STREET.—Although the past week seemed a trifle dull, a million shares more than the week a year ago were sold. There continues some uncertainty and uneasiness as to rates for money, but present conditions are happily against the loading up of the market with further batches of untried securities in huge volume. During the week 1755 shares of Western Union were sold, closing at 90⅝. Of General Electric 6115 shares exchanged hands between 118¾ and 120½, closing at the former figure. On strike rumors and sales of 250,000 shares Brooklyn Rapid Transit declined to 112⅞. Metropolitan Street Railway, on 20,795 shares, was weaker at 222½, and Manhattan, on 186,295 shares, closed at 119¼. In Boston, American Bell Telephone, on sales of 261 shares, declined from 353 to 346; Boston Elevated was firm at 108½. In Philadelphia Electric Storage Battery advanced to 160, showing a gain of about 20 points in the last fortnight. Union Traction rose to 42, Pennsylvania to 68, and National Electric to 10¼. Electric Company of America was steady at 18¾. In the New York outside market Electric Vehicle common closed the week at 101 to 103 and preferred 118 to 125; Electric Boat, common, 14 to 18, preferred 42 to 47; General Electric Automobile, 17 to 24; General Carriage Company, 34½ to 38; New York Electric Vehicle Transportation, 24½ to 25¼; New England Electric Vehicle Transportation, 11¼ to 11¾; Illinois Electric Vehicle Transportation, 7 to 7½.

EXCELSIOR ELECTRIC COMPANY.—Mr. Charles E. Dustin has been appointed temporary receiver for the Excelsior Electric Company, whose office is at 115 Broadway, with a factory at 198 to 216 Willoughby street, Brooklyn, by Judge Gildersleeve of the Supreme Court, on the application of the following Directors: Charles T. Hughes, W. S. Brayton, Irving S. Keeler, Charles E. Dustin and Clarence R. Dean, in proceedings for the voluntary dissolution of the corporation. The company passed into General Electric control some time ago, and is being reorganized. It was stated that the company is pressed for payment, has no available funds to pay its debts or carry on the business, and is unable to procure any money for that purpose. Interest on its bonds is long past due, and a judgment for $3762 in favor of the General Electric Company was taken against the company some time ago. The total liabilities are $230,621, of which $166,000 are bonds secured by a mortgage on all its effects, past due interest on bonds $48,970, accounts and notes payable $15,651, of which $10,967 is due to the General Electric Company. The assets consist of machines, tools, patterns, materials, etc., $46,903, nominal value; office furniture, $163, and fifty-five patents, the value of which is not given in the schedules. The company was incorporated in August, 1881, with a capital stock of $500,000. Since then the company has passed through a number of changes, and in May, 1898, passed into the control of the General Electric Company, which put in Charles E. Dustin as president and treasurer, and which has since controlled it. There are thirty-six stockholders, the largest being C. T. Hughes, $384,500, and J. N. Smith, Lynn, Mass., $35,500. Bonds for $166,000 were issued on Dec. 31, 1888, secured by a mortgage on its plant and other assets. The receiver is authorized to continue the business to work up the materials on hand

at the factory. Francis C. Cantine was appointed referee, and the order to show cause was set down for Aug. 4.

A BIG DEAL IN NEW JERSEY.—A financial deal which, according to brokers and dealers in Jersey securities, looks toward the amalgamation of all the gas, electric light and trolley interests of the northern part of New Jersey into a corporation, the capital of which will be between $300,000,000 and $400,000,000, has been started by the United Gas Improvement Company, of Philadelphia, the owner of the recently formed United Electric Company of New Jersey. If consummated, it will be one of the largest concerns in the country. Agents of the last named company have sent out circulars bidding 250 for the stock of the People's Gaslight Company, of Jersey City, and the Jersey City Gaslight Company, and 375 for Hoboken Gaslight Company stock. The only Hudson County gas company which the Philadelphia corporation is not trying to buy is already the property of the United Gas Improvement Company. According to report, the scheme is to put up a giant plant on the meadows, between Newark and Jersey City, and supply from it gas for Hudson and Essex Counties. Already the United Gas Improvement Company, or the capitalists most heavily interested in its projects, control almost the entire trolley and lighting interests of New Jersey's northern counties. Including underlying bonds and stocks, the capital of the companies absorbed in the recent big consolidations, and all brought practically under the same control, is as follows: North Jersey Street Railway Company, $60,000,000; Essex & Hudson Gas Company, $22,000,000; United Electric Company, $40,000,000; Hudson County gas companies, $20,000,000; White Line & North Hudson County Railway, $15,000,000. These consolidations will be followed, according to report, by the amalgamation of the trolley lines and gas companies of Paterson, whose total capitalization is now about $20,000,000.

THE STATE OF TRADE.—Discussing the favorable state of trade, Dun's review of the week says: "Foreign trade is more satisfactory, exports for the week being slightly larger than last year. Exports of staples in June, though much smaller in breadstuffs, owing to low prices, were in all only $6,215,026 less than last year, while exports of other domestic products increased $8,031,461, making the excess of exports for the month $35,137,937, and the excess of exports of merchandise and specie for the fiscal year $504,555,497. While exports of the chief staples have decreased $85,878,380, manufactured exports have increased nearly as much, making the total decrease only $5,921,608. Bradstreet's says of domestic conditions: "Bank clearings are of enormous volume for the season, aggregating $1,933,655,528 for the week, a gain of 17 per cent. over last week, of 61 per cent. over this week a year ago, of 102 per cent. over 1896, of 93 per cent. over 1894, and of 70 per cent. over 1892. Business failures number 174, against 136 last week, 238 in this week a year ago, 247 in 1897, 255 in 1896, and 214 in 1895. June railroad earnings are not only the best of any reported this year, but show the heaviest aggregate gain reported since May, 1898, as a result of an unprecedented grain tonnage, marked industrial activity and a large return movement of freight Westward. Gross earnings of 109 systems aggregate $45,438,393, an increase of 13.6 per cent. over June a year ago, comparing with a gain of only 7.7 per cent. in May, and the heaviest gain reported since May, 1898, when the gain was 13.7 per cent. The Grangers make the best showing, with an increase of 23.6 per cent. over June last year, followed by the gain of 14.5 per cent. by the Pacific roads, and 13.7 per cent. by the trunk lines. Increases by coal, Southwestern and Southern roads vary from 12 to 13 per cent., the central Western roads gain 10 per cent., and the Mexican group 14.5 per cent. Of 101 systems, 88 show increases, and in five groups of roads every company shows gains. For the six months 109 roads, operating 95,000 miles, show earnings of $277,398,314, a gain of 6.5 per cent. over 1898, and following progressive gains for five years past."

Special Correspondence.

NEW YORK NOTES.

STORAGE BATTERY CARS.—The Third Avenue Railroad Company confirms the report that it is considering the adoption of storage battery cars on the Dry Dock, East Broadway & Battery line.

MUNICIPAL ELECTRICIANS.—The National Association of Municipal Electricians has secured the regular convention reduced rates for its meeting at Wilmington, Del., September 5 to 9, inclusive.

A NEW TELEPHONE EXCHANGE, to be known as the Madison Square Exchange, was opened at 30 East Twenty-ninth Street last Monday. This exchange will relieve the Eighteenth and Thirty-eighth Street exchanges. It has 1100 subscribers and is operated on the common battery system, which is now used in the Riverside and Harlem exchanges. Sixty operators will be employed in the new exchange.

THE ARGONAUT.—The new "submarine automobile," the latest type of Mr. Simon Lake's Argonaut, was launched last week at the Erie Basin, Brooklyn, and it is said she may presently try a trip across the Atlantic. A description has already appeared in these pages. The new boat is 66 feet long and 12 feet in depth, including her superstructure. She is equipped with a 60-hp gasoline engine, two small dynamos, storage batteries, etc. A trial trip will be made off the Atlantic Highlands.

STREET RAILWAY STRIKE.—The Borough of Brooklyn was somewhat disturbed by a strike on the Brooklyn Rapid Transit system during the earlier part of the week, but it appeared to be petering out on Tuesday. At that time the leaders succeeded in tying up the Second avenue and one or two other lines in Manhattan. So far as observable the strike has been engineered for stock jobbing purposes, and there is absolutely no sympathy with it on the part of the public. The vast majority of the men on the Brooklyn and Metropolitan systems say they are being well treated.

BROOKLYN RAPID TRANSIT AFTER THE DEKALB AVENUE LINE.—It is stated that negotiations are again in progress looking to the acquisition by the Brooklyn Rapid Transit Company of the Coney Island & Brooklyn Railway, better known as the DeKalb Avenue road. The DeKalb Avenue line is the only one in Brooklyn which is not included in the Rapid Transit system. It is expected in railroad circles that within a year the Rapid Transit Company will control the entire railway system in Brooklyn, surface as well as elevated.

GENERAL ELECTRIC RUMORS.—A number of reports made their appearance last week as to the General Electric Company. One in the form of a special dispatch from Lynn, Mass., of July 15, said: "It has been given out here by officers of the General Electric Company that the plant here will be doubled, and that sixty-nine acres of land have been purchased for that purpose. The manufacture of automobiles will be begun, and much of its general business will be transferred to the Lynn works." The report that the company is to engage in automobile work is denied as entirely unauthorized and incorrect. It is also stated on authority that there will be no shifting of men or departments from Schenectady to Lynn. The company's property at Schenectady is held in fee simple, and although it has already 1,200,000 square feet of floor space there, it still has 60 acres of its own land available for extension.

PITTSBURG NOTES.

MR. ALBERT SCHMID, who for many years was the superintendent of shops of the Westinghouse Electric & Manufacturing Company, but went to France in the interest of the company three years ago, is now on a visit in this city with his wife and son. Mr. Schmid will soon return to Paris.

THE PHILADELPHIA COMPANY is installing two 800-kw alternating current generators in the central station plant at Glenwood for the purpose of increasing the electric lighting facilities at the East End of this city.

THE PITTSBURG & BIRMINGHAM TRACTION COMPANY is making great improvements upon its property. The car tracks are being renewed on the downtown part of the line and several new generators are being added to the power house.

WESTERN NEW YORK NOTES.

THE INTERNATIONAL TRACTION COMPANY is getting the right of way for an extension of its line in Lockport through various streets of that city. The proposed extensions will allow it to reach several mills for freight and passenger purposes.

THE NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING COMPANY has received another new 2500-hp turbine, which is to be installed in its power station at the water's edge in the gorge. It will be direct connected to two 1000-hp generators that will furnish current to the lower works of the Pittsburg Reduction Company.

OHIO NOTES.

THE TOLEDO & ADRIAN ELECTRIC RAILWAY COMPANY, of Toledo, has been incorporated for $25,000, to construct an electric railway between Toledo, Ohio, and Adrian, Mich.

THE CLEVELAND ELECTRIC RAILWAY COMPANY has favorably considered the proposition to build an elevated electric railway through the portion of Cleveland known as the "flats," and the road will be constructed as soon as possible providing franchises can be secured.

MR. P. T. FARNSWORTH, representing the North Electric Company, of Cleveland, has been successful in securing over 500 subscribers for a new telephone system at Chattanooga, Tenn. The Chattanooga City Council has been asked for a franchise, which will probably be granted.

THE DAYTON, SPRINGFIELD & URBANA ELECTRIC RAILWAY COMPANY has secured franchises from the Urbana council and the Champlain county commissioners. This completes the right of way for the line, which will be built at once. It is proposed to operate high speed electric cars.

ELEVATED RAILWAY FOR THE CLEVELAND FLATS.—Mr. H. A. Everett is at the head of an enterprise to build an elevated electric railway over that portion of Cleveland known as the "flats." The "flats" is a wide district of low lands following the river bed, and, although it is densely covered with manufacturing establishments, it is without street railway service.

INDIANA NOTES.

LIGHT AND POWER COMPANY.—The Jeffersonville Light & Power Company, of Jeffersonville, has filed articles of incorporation with the secretary of state. The capital stock is placed at $19,500. J. C. Knight, H. C. Knight and L. A. Irvin are named as directors.

IMPROVED STREET RAILWAY SERVICE.—General Manager McGowan, of the Indianapolis Street Railway Company, in answer to a demand by the Board of Public Works for an improved service, wrote that the company had experienced much difficulty in getting cars and that the company could not obtain complete equipment before Aug. 1. The new cars require double trucks and the company found that a premium would have to be paid to get the trucks before fall on account of the scarcity of iron.

WISCONSIN NOTES.

NEW TELEPHONE LINE.—The Wisconsin Bell Telephone Company is putting in a new line between Oconto and Stevens Point.

THE WISCONSIN TELEPHONE COMPANY has purchased property in La Crosse, Wis., in which will be built a local office and exchange building.

MR. A. PETERMAN, formerly of the firm of Peterman & Wallber, who recently dissolved partnership, has opened offices at 24 Cawker Building, and will do an electrical contracting and supply business.

THE BADGER ELECTRIC LIGHT COMPANY'S plant, at Racine, has been absorbed by the Milwaukee Electric Railway & Light Company, and John I. Beggs will be manager of the plant. This announcement was officially made July 10 by Mr. Beggs. What price was paid for the plant is not known, and the stock has not yet been transferred, but the Badger Company has moved its offices to those of the Belle City Electric Company, and the interest of the two plants consolidated. It is said that the lighting interests will be distinct from the electric railway business. Phillip Korst, who has been superintendent for the Badger Company, will be retained to conduct the lighting business of the two plants. The Badger Company is stocked for $75,000, and is bonded for $80,000. It has 130 miles of wire, operates 8000 incandescent lamps, 329 arc lamps, and furnishes 150-hp. The lines of the company will be overhauled, new poles put in, and there will be a reduction in price of lighting. The Milwaukee Electric Railway & Lighting Company recently purchased property on Lake avenue, and it is said a new power house will be built and power put in to increase the lighting capacity.

A NEW RAILWAY PROJECT.—An east Lake Winnebago shore electric line to carry passengers and baggage is the gist of an important railway project which became known to the public July 13. The proposed line is to run from Fond du Lac to the northern end of the lake, and will touch Appleton, though the route has not been definitely laid out. Two companies are considering the project, one of them being, it is reported, the Fond du Lac Electric Company and the other an association of Eastern capitalists. A railway man was the first to divulge the scheme, and upon investigation several additional facts regarding the proposition were learned. Civil engineers have been requested to look over the ground and make a report upon the country through which the line is likely to pass. The proposition which is the most likely to be adopted is that of the Fond du Lac Electric Company, which proposes to extend its lines and cut into the interurban lines, which will be built in the Fox River Valley, either at Kaukauna or Appleton, probably at the latter city. The line as proposed will skirt the east shore, reaching Pipe Creek, or Calumet, Brothertown, Stockbridge, High Cliff, Sherwood and hence to Appleton, which is a more desirable terminus for the route than Kaukauna. It is also learned that the real estate men have been receiving options on all the available property east of the lake. In regard to the statement that representatives of the Eastern men have recently been on the field, W. H. Holcomb, of the Fox River Valley Electric Railway Company, admitted when questioned that he had looked over the field, but said that he had made no report, and had made no surveys.

MINNESOTA NOTES.

RAPID TRANSIT BETWEEN ST. PAUL AND MINNEAPOLIS.—Mayor Gray, of Minneapolis, has vetoed a measure authorizing the Minneapolis Street Railway Company to run certain cars between that city and St. Paul (a distance of a trifle less than 12 miles) in half an hour, the time to be gained by making fewer stops and side-tracking local cars, rather than by an increase of speed, and to charge an additional fare of five cents for such fast service. This ordinance was passed by the council with only two opposing votes and in response to an almost unanimous demand by the business men of the city. The travel between the two cities over the Interurban line is very heavy, and the time consumed, nearly an hour, is a very burdensome tax upon the time of men engaged in active business who are called upon to frequently make the trip. It is argued that inasmuch as the above scheme will enable the company to separate the through from the local passengers, it will be possible to not only haul the through passengers cheaper than at present on account of fewer stops, but render the total number of cars less, because the through cars would thus make double the present number of trips, and hence the charge would be a gain to the company at the present rate of ten cents each way. About 50 per cent. are local passengers. The ordinance will, no doubt, be passed over the mayor's veto, as "rapider" transit is in demand and the railway company does not seem to be in duty bound to furnish it without extra compensation.

ST. LOUIS NOTES.

VENICE STREET RAILWAY FRANCHISE.—The City Council of Venice, Ill., passed an ordinance granting to D. R. Francis, Fred E. Allen and E. J. Spencer, owners of the Venice, Madison & Granite City Electric Street Railway, a franchise for the construction and operation of an electric street railway in Venice. The life of the franchise is 20 years. It is the purpose of the company to build through Brooklyn to East St. Louis.

POSSIBLE COMBINATION OF ELECTRIC INTERESTS.—The rise in Missouri-Edison Electric Light & Power Company's stock has given currency to reports that with the Imperial Electric the companies would consolidate with the street railway syndicate. It is suggested that the consolidation would be a great economy as the lighting companies could use the excess current generated by the railway power houses at night for illuminative purposes.

THE UNITED STATES TELEPHONE MANUFACTURING COMPANY has filed articles of incorporation; capital stock, $10,000, one half paid in. Frederick A. Churchill, Jr., Arthur F. Garesche and William G. Lackey are the incorporators. This is a branch of the Indiana Company. The company manufactures telephones and telephone supplies and its business consists of putting in house telephones and furnishing exchanges in small cities. Mr. F. A. Churchill is president. The company's offices are at 815 Market Street.

THE CENTRAL TRACTION COMPANY, of St. Louis, has accepted the provisions of the recent street railway law, under which act it is permitted to do business by paying a certain fee, which for this company was $2500. This is a benefit which accrues to the state under the street railway consolidation bill, as all companies which intend to avail themselves of the provisions of this bill must pay the state a certain amount when accepting the measure. Every street railway company in Missouri must pay this fee in proportion to its incorporation fee.

ANOTHER BELT LINE PROJECT.—A fourth application for a belt line franchise was filed in the St. Louis County Court at Clayton last week. The application was made by the Wellston Creve Coeur & St. Charles Railway Company. The route asked is a semi-circle around the city from Jefferson Barracks to Chain of Rocks. The application is for a 50-years' franchise and the privilege of using electric or any other motive power, compensation being $1000 upon acceptance of the franchise, $5000 on the day work is begun and an annual payment of 2½ per cent. of the gross earnings of the road during the life of the franchise. The company agrees to accept the franchise within 60 days after approval, to begin work within one year and complete and put the line into operation within five years.

SPENCER LINES SOLD.—Circulars have been sent out to all the stockholders of the National Railway Company of Illinois and the Southern Electric Railroad Company, announcing that the holders of two-thirds of the capital stock of these companies had entered into a contract with the Maryland Trust Company, of Baltimore, for the sale of the properties of the companies on July 15. The sale has been made to Brown Bros. & Co. on a basis of $150 a share for the stock of both companies. The first cash payment will be $25 a share, payable July 15. The balance is to be paid on or before Jan. 1, 1900. It will bear interest at the rate of 4 per cent. per annum until paid. The circulars are signed by Corwin H. Spencer, W. J. Orthwein and A. H. Bauer. The Maryland Trust Company has been selected to act for Brown Bros. in the deal.

CANADIAN NOTES.

THE MONTREAL ELECTRIC STREET RAILWAY COMPANY'S arrangements for insuring the employees have been announced to the staff. The schedule of compensation for injuries either on or off duty is as follows: Death from accidental injuries, $1000; loss of both eyes, $1000; loss of both hands, $1000; both feet, $1000; one hand and one foot, or one hand or foot, and one eye, $1000; one hand, one foot, or one eye, $500. If an accident is met with which does not result in the loss of any of the members mentioned, but which incapacitates from working, the sum of $5 per week for a period not exceeding 26 consecutive weeks, will be paid. If an employee becomes afflicted with any of the following diseases, similar compensation will be given: Typhoid, typhus, scarlet fever, smallpox, pneumonia, appendicitis and diphtheria.

ANOTHER WATER POWER DEVELOPMENT.—La Societe Industrielle du Comte de Maskinonge, of which Mr. Moise Paquin, of Maskinonge, Que., is one of the principal promoters, is negotiating with American capitalists for the sale of the St. Ursula Falls, of the Maskinonge River, Que., which falls, it is said, can be made as useful for industrial purposes, if not superior, to the Shawinigan Falls at Grand Mere, on the St. Maurice River, Que. The St. Ursula Falls have a decline of 180 feet in a few arpents, and no less than seven cascades, at the foot of each of which industrial establishments can be erected on solid rock foundations. The channel is guarded by solid rock. Thousands of electrical horse-power can be developed there, and it is thought could be made to become a formidable rival of Grand Mere. The falls are situated at a distance of nine miles from the St. Lawrence River.

ELECTRICAL CONSOLIDATION IN OTTAWA.—It is said that the two largest electrical power companies of Ottawa, Ont.—The Metropolitan Electrical Company and the Deschenes Electrical Company—are about to amalgamate, and will practically control all the valuable available water power in the immediate vicinity of Ottawa. The chief reason for the deal is said to be the anxiety of the Metropolitan Company to start at once to sell light and power in Ottawa. While the 5000-hp, which the company is now developing within a few miles of Ottawa, will be available before snow flies, it is considered to be an advantage to get an immediate start from the use of power already developed by the other company. The latter company having no franchise to operate in Ottawa, its surplus power, as it now stands, is of no use. The Metropolitan Company, it would appear, is following the example set by the Cataract Power Company, of Hamilton, Ont., which has bought up all the power in sight in that vicinity, and, in addition, has purchased the Hamilton street railway and all the radial roads running into that city. The Cataract Company developed 5000-hp at 40 miles from Hamilton at an enormous expense and transmits it by copper cables. A New York syndicate was behind the company, furnishing the capital for the purchase of the street railway and the radial roads, and so successful has proved the venture, it is said, that nothing less than $500 will buy a share in the Cataract Power Company at the present time. The Metropolitan Electrical Company, however, thinks it has a more valuable property than that now owned and controlled by the Cataract Power Company, as it is developing power at comparatively very small cost, and within four or five miles from Ottawa. It is said that the machinery and plant of the Metropolitan Company will be of the most modern and improved design and the facilities of the very best. As there will be a number of suburban electric railways projected around Ottawa in the near future, all of which will require power, the Metropolitan Company will find a ready market for all the power required by these radial roads.

General News.

THE TELEGRAPH AND TELEPHONE.

LA GRANDE, ORE.—The Inland Telephone Company has established an exchange at Elgin.

MONTICELLO, FLA.—Mr. Drew, of Madison, proposes to establish a telephone exchange in this place.

BURLINGTON, IOWA.—The Postal Telegraph Company is to build a line into Burlington, with a branch to Keokuk and Fort Madison.

CHATTANOOGA, TENN.—Mr. P. T. Farnsworth, of Memphis, Tenn., is considering the establishing of a telephone exchange in Chattanooga.

SAN BERNARDINO, CAL.—A telephone line will be run through the Yucapie Valley by the Oak Glen Park and South Mountain Water companies.

CHICAGO, ILL.—It is expected that the Illinois Telephone & Telegraph Company will have a capitalization of $5,000,000 4½ gold bonds and $5,000,000 stock.

MEMPHIS, TENN.—The city has entered into a contract with the People's Telephone Company, of New Orleans, for the introduction of its system in Memphis.

OLEAN, N. Y.—The N. Y. & P. Telephone Company has arranged to extend its long-distance service to Otto, East Otto, Eddyville and New Albion in this county.

DENVER, COLO.—The Colorado Telephone Company has been extending its lines outside of the city and state. An exchange of 50 subscribers has recently been opened at Raton, N. M.

JACKSON, MISS.—The Cumberland Telephone Company has absorbed the People's Company in this place. The latter concern has 400 subscribers. The consideration is said to have been $25,000.

JOLIET, ILL.—The Northwestern Telephone Company has been incorporated, with a capital stock of $2500. The incorporators are Edward R. Conkling, George J. Cowing and George W. Young.

"THE END JUSTIFIES THE MEANS."—The people of Delina, Tenn., recently gave an ice cream supper to raise funds for the purpose of securing the extension of the telephone line from Petersburg to Delina.

TOPEKA, KAN.—The Topeka Council recently granted a franchise to a new company to operate a telephone system here. This action has caused the Missouri & Kansas Telephone Company to reduce its rates to $2 per month.

EAU CLAIRE, WIS.—The Mississippi Valley Telephone Company's toll lines in northern Wisconsin, and the Menominee, Eau Claire and Chippewa Falls exchanges are to be turned over to the Wisconsin Telephone Company.

FRANKFORT, KY.—Manchester, in Clay County, is to be connected with the outside world by a telephone line. Clay County is completely cut off from civilization, not having a mile of railway, telegraph or even ordinary turnpike.

FORT BENTON, MONT.—The Lewiston Telephone Company has been incorporated by F. E. Wright, A. W. Warr and T. J. Warr. The capital stock is $10,000. A telephone line will be constructed between Lewiston and Gilt Edge.

SYRACUSE, N. Y.—The Independent Telephone & Telegraph Company has been organized in this city, with a capital stock of $5000. The directors are Ernest I. White, Edward Barneman, Syracuse; J. J. Jernigan and John L. Wentz, Scranton, Pa.

WABASH, IND.—The Town Council at North Manchester has granted a franchise to the Central Union Telephone Company to string a toll line in that place. It is the purpose to have 60 miles of line between Wabash and Goshen in operation not later than Sept. 1.

INDIANAPOLIS, IND.—It is stated that the Dunkirk & Pennville Independent telephone line has been purchased by the Hartford City Central Union Telephone Company. The independent line runs between Nottingham, Pennville, Dunkirk, Mill Grove and Hartford City.

WATERTOWN, N. Y.—The Citizens' Telephone Company has been organized, with a capital stock of $50,000. The directors are S. C. Sherman, S. F. Bagg and Robert J. Buck, Watertown; Robert Bliss, Howard Gallup, Robert S. Monroe and James K. Whitaker, New York.

YORK, PA.—The York Telephone Company has been purchased by a local syndicate which will pay $15 per share for all the stock, the par value being $10. The company has paid 5 per cent. annual dividends ever since its organization in 1896. The management will remain practically the same.

EASTON, MD.—A syndicate of Philadelphia capitalists has secured control of the Union Telephone Company of Calvert County. The company will be reorganized, the plant enlarged, and connections will be made throughout the eastern shore peninsula. The scheme is to give the entire Maryland and Delaware peninsula a complete telephone service.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company, which is operated in opposition to the Bell Company, has obtained many thousands of subscribers in this city and vicinity. It is charging $24 a year for party lines; $36 for individual lines to residences, and $48 for business houses. The Bell Company is now putting in residence instruments for $1.50 per month.

NIAGARA FALLS, N. Y.—The Niagara Falls Telephone Company has been incorporated with a capital stock of $100,000. The points to be connected with the city of Niagara Falls are the towns of Lewiston and Porter, and the villages of Lewiston, Youngston and Lasalle. The directors are: Samuel B. Rawson, Fred H. Sudro, James A. Dake, Irving H. Griswold, of Elyria, O.; William R. Campbell, James E. Rock, Allan H. G. Hardwick and Walter A. Horne, of Niagara Falls.

SPOKANE, WASH.—A suit for $205,000 damages has been commenced by the Spokane and British Columbia Telephone & Telegraph Company against the International Telephone & Telegraph Company, the former alleging that the defendant had cut its wires leading into Spokane from British Columbia and had violated the agreement in the matter of receiving and transmitting messages. A temporary injunction was granted restraining the defendant from further interference with the plaintiff's business.

ELECTRIC LIGHT AND POWER.

KANSAS CITY, MO.—Mr. James D. Wade, of St. Louis, has applied for a franchise to erect an electric light plant in this city.

HOLLIDAYSBURG, PA.—The Bellwood Electric Light Company, of Bellwood, was sold a few days ago at sheriff's sale for $7100.

OTTAWA, ILL.—The Fox River Electric Light & Power Company has been organized here, with a capital stock of $10,000, by L. W. Merrifield, L. B. Merrifield and T. W. Burrows.

HOUMA, LA.—The Houma Lighting & Ice Manufacturing Company is now supplying this place with electric light, the electric light plant being run in conjunction with the ice factory.

REDWOOD CITY, CAL.—Bonds for an electric light plant will be sold and then the trustees will begin the work of installing the plant, which, it is thought, will be in operation by Oct. 1 next.

BALTIMORE, MD.—It is stated that a deal has been arranged for the sale of the Peninsula Electric Light & Power plant at Newport News to the Newport News & Old Point Railway Company for $200,000.

WHEELING, W. VA.—The Ohio Valley Electrical & Motor Power Company has been organized, with a capital stock of $500,000. The incorporators are M. Horkheimer, F. H. Lange, H. W. McLare, C. M. Fressell and J. F. Conff, all of Wheeling.

MINNEAPOLIS, MINN.—The Coon Rapids Power Company has been incorporated to develop the water power at the up-river city limits. The capital stock is $200,000, and the incorporators are Thomas Lowry, Calvin G. Goodrich, Mart B. Koon and Frederick Weyerhaeuser.

JERSEY CITY, N. J.—The Rockaway Electric Light & Improvement Company has been organized to construct and operate gas and electric light works. The capital stock of the company is $15,000, and the incorporators are Anthony Blum, Brooklyn, N. Y.; Kent K. Stearns, Jersey City, and Isaac Blum, New York City.

CHARLESTON, W. VA.—The Howell & Shanklin Construction Company has been organized, with a capital stock of $100,000, to construct and equip water works, electric light and power plants, etc. The incorporators are Clark Howell, J. R. Shanklin, Charleston; J. W. Spencer, W. R. Gunn and H. R. Howard, Point Pleasant.

WHEELING, W. VA.—The National Light, Heat & Power Company has been organized here for the purpose of manufacturing, generating, supplying and selling electricity for light. The capital stock is $500,000, and the incorporators are J. Piedell, J. A. Miller, C. H. Copp, J. T. Adams, all of Wheeling, and R. C. Dalsell, of Leatherwood.

CADILLAC, MICH.—The Pine River Electric Light & Power Company, with headquarters at this place, has just been incorporated, with a capital stock of $60,000. The main object of the company is to transmit electric current from Tustin to Cadillac, a distance of about 16 miles, for light, heat and power. It is calculated that 2000-hp will be transmitted. The land and rights of way have been procured, and it is expected to have the system in operation by Sept. 1.

THE ELECTRIC RAILWAY.

WILKESBARRE, PA.—The Harvey's Lake Electric Railway has been sold to the Wilkesbarre & Wyoming Valley Traction Company.

NEW ORLEANS, LA.—The street railway on Henry Clay Avenue is to be rebuilt and probably extended. It is controlled by the New Orleans City Railway Company.

CLEVELAND, OHIO.—Mr. W. W. Hazzard has the contract to build an electric railway from Canton to Alliance for the Stark Railway Company. The distance is 20 miles.

KANSAS CITY, MO.—Messrs. L. E. Meyer & Co., of Chicago, have secured the contract to change the West Side Railway over to an electric road. The contract includes the laying of new rails.

THIRD AVENUE RAILROAD COMPANY of New York announces that it is considering the desirability of equipping the Dry Dock, East Broadway & Battery line with storage battery cars.

AUGUSTA, GA.—It is stated that the proposed electric railway between Augusta and Aiken will include the towns of Bath, Langley and Graniteville, S. C. The road will be 15 miles in length.

CLEVELAND, O.—The 800 union employees of the Cleveland Electric Railway Company have again gone out on strike, tying up 12 out of 14 lines. They claim that the company has not lived up to its agreements made during the last recent strike.

WHEELING, W. VA.—Messrs. John S. Welty and Samuel H. Harper, of Wheeling, are interested in a company which proposes to build an electric railway in the city and suburbs. The name of the new company is the Wheeling, Wellsburg & Lazearville Railway Company.

CHICAGO, ILL.—The newly constructed line of the Chicago Traction Company from Blue Island to Harvey is now in operation. The cars are operated by storage batteries, and give Harvey direct street car communication with Chicago. The fare for the entire distance is 5 cents. The Illinois Central and Grand Trunk roads charge a uniform rate of 22 cents for a single fare between Chicago and Harvey.

CHICAGO, ILL.—Trolley funeral cars are a recent innovation on two of the South Side electric railways. The Calumet Street Railway Company and the Chicago Electric Traction Company both have funeral cars.

LYNCHBURG, TENN.—Work has been commenced on the electric railway from Lynchburg to Tullahoma, Tenn The distance is 14 miles, and it is calculated that the road will cost about $175,000. Mr. J. Y. Yarlington, of Lynchburg, represents the syndicate which is building the road.

GLOUCESTER, N. J.—An ordinance has passed first reading in the council giving to the Delaware River & Atlantic City Railway Company a franchise to lay tracks from the Gloucester ferry through the city. The object of the company is to build an electric railway, 52 miles in length, to Atlantic City. The company proposes to use the third-rail system.

ATLANTA, GA.—The Board of Electric Control has issued orders to the city electrician to prohibit in the future the erection of any poles in the city for the use of electric railways unless the company which owns the poles shall have previously constructed a line of bona fide track along the streets where the poles are placed. The action of the board will prevent the erection of poles on streets as soon as franchises have been granted.

SING SING, N. Y.—The Ossining electric railway is to be sold in August for non-payment of taxes. The property includes the tracks, cars, poles and wires. Last year the village bought in the road. The amount of the road's general taxes still unpaid is $567.12. Negotiations are on foot to dispose of the property so that the road may be extended to connect with the White Plains, Mamaroneck, Tarrytown and other lines in the county.

WAUKEGAN, ILL.—The Chicago & Milwaukee Electric Railway Company has recorded a mortgage covering its road for $1,500,000. It was given to the Cleveland Trust Company and the Royal Trust Company to cover funds secured to extend the line from Highland Park to Evanston. It is also contemplated to extend the line to the north and west sides of this city for local service. Franchises for these extensions will soon be asked for.

STORAGE CARS FOR WASHINGTON.—The Washington Traction Company has been placing orders for ten storage battery cars, duplicates practically of those used on the Chicago & Englewood road, for use on its Anacostia & Potomac River Railroad. The batteries will be chloride. The cars are old ones of the St. Louis Car Company, built with two Westinghouse motors. Two of them may be used on the P street loop. The Anacostia line gives three miles of double track. Current will be taken through a reducer from the underground conduit system, at a vault adjoining the tracks; also, if it should prove necessary, from the Edison system. While partly a test, the main reason is that the Pennsylvania Railroad is elevating its tracks, rendering the adoption of other methods difficult.

THE AUTOMOBILE.

PHILADELPHIA is taking steps to form an automobile club, and the prominent owners of horseless carriages are insisting upon their right to enter Fairmount Park..

ILLINOIS.—Mr. Samuel Insull, president of the Illinois Electric Vehicle Company, has been in New York making arrangements to start up the ply-for-hire automobile service in Chicago as soon as possible.

AUTOMOBILE ISSUE IN BOSTON.—Mayor Quincy has vetoed an amendment to a city regulation the object of which was to place the control of automobile licensing in the hands of the Board of Aldermen.

NEWPORT, R. I.—A large number of electric and other automobiles are now in use in Newport, and driving them is the fashionable thing. All the society people are taking lessons. It is noted that the horses are not scared by them and that they have not caused any runaway accidents.

SEWICKLEY, PA.—An automobile company is being formed and five vehicles have already been ordered. The incorporators are E. B. Taylor, general superintendent of the Pennsylvania Company; Dr. R. J. Murray, president of the Sewickley National Bank; E. P. Coffin, cashier of the bank, and Dr. H. S. Jackson. The service is to be running by September.

AUTOMOBILE MAIL WAGONS.—The post office department officials in Washington have expressed the highest satisfaction with the report sent in by Postmaster Dorr, of Buffalo, relative to the recent test of automobiles made in this city for collecting mail from the letter boxes on the streets. They see marked economy in a regular service of automobiles, and possibly for rural collecting and delivery.

MANITOWOC, WIS.—The Manitowoc Traction Company has been organized and has placed an order for four automobile passenger coaches. Two will be used for transportation of passengers about the city, one will be run between Manitowoc and Two Rivers and the fourth will run between English and Silver lakes and this city. The automobiles will be run during the entire year and it is the intention of the company to purchase additional coaches as the business develops.

LARGE ORDERS FOR AUTOMOBILES.—Mr. Isaac L. Rice, president of the Electric Vehicle Company, announces that he has placed orders for electric carriages of various sorts to the number of 4200. The total cost of these vehicles will be about $8,000,000. Mr. Rice states that the delivery of the vehicles on the orders will begin about the latter part of July. The orders are given to the Columbia & Electric Vehicle Company, which is one of the subsidiary companies of the Electric Vehicle Company. The facilities of the Columbia & Electric Vehicle Company have lately been enlarged by the addition of the New Haven Carriage Company, as noted in these pages last week.

AUTOMOBILES GROWING IN FAVOR IN OHIO.—The use of electric vehicles for public service is rapidly gaining favor in Ohio. At Columbus an electric automobile trolley wire repair wagon has been put into service by the Columbus Street Railway Company, and it is proving a marked success. At Cleveland, Chief Dickinson, of the fire department, has practically decided to purchase an electric automobile to convey him to fires, and at present he is making careful inquiry into the respective merits of the various machines now on the market. The city of Akron is to have a horseless patrol wagon. It is to be of the electrical type, and after canvassing the situation the city electrician has decided to build it himself.

PERSONAL.

MR. CHARLES F. THOMPSON, secretary, treasurer and director of the Lane & Bodley Company, Cincinnati, Ohio, resigned these positions on July 1 last. Mr. Thompson had been with the company 35 years.

MR. MAX LOWENTHAL has been appointed by Director Colton, of the Newark (N. J.) Technical School, instructor in theoretical and applied electricity there. The school will equip for electrical laboratory and engineering studies.

DR. E. R. CORSON, of Savannah, Ga., a well-known medical practitioner and an expert radiographer, has been visiting New York for the past week, studying the latest literature and devices on the subject. Some of his Röntgen ray work is very fine.

LIEUTENANT COMMANDER S. DANA GREENE, of the General Electric Company, with his wife, leaves this week for a well-earned six or seven weeks' vacation in Europe. It is his first holiday since active service in the late war and going on the staff of Governor Roosevelt.

MR. A. V. GARRATT, during the recent meeting of the American Institute of Electrical Engineers in Boston, secured a fine group photograph of leading members in attendance. Copies of it have been sent to those who were there, and it furnishes a pleasant souvenir of a profitable convention.

Trade and Industrial Notes.

THE SAFETY THIRD RAIL ELECTRIC COMPANY, New York, has removed its offices from Temple Court to 40 Wall Street.

MR. C. W. MOFFET has been appointed as manager of the Boston office of the Heine Safety Boiler Company, St. Louis, Mo., in place of Mr. Russell Walker, recently resigned.

THE MARYLAND TELEPHONE COMPANY has purchased a site in Baltimore and is having plans prepared for the erection of its proposed telephone factory. The site cost $80,000.

MESSRS. NAUGLE, HOLCOMB & CO., 810 Old Colony Building, Chicago, have appointed Mr. W. H. Missing as their general agent, with office at 642 Century Building, St. Louis, Mo.

MR. B. BLUM writes us from 699 Broadway, New York City, that the projected Rockaway plant referred to in our last issue is not on Long Island, but in New Jersey. The Rockaway (N. J.) Electric Light & Improvement Company is in the market for apparatus.

MESSRS. J. B. COLT & CO., 3 West 29th Street, New York, or any of their agents in the principal cities will be glad to send to any address a copy of their catalogue "Criterion" automatic acetylene gas generator.

THE GENERAL ELECTRIC COMPANY has issued bulletins Nos. 4186, 4187, 4188 and 4189, devoted, respectively, to single-phase, alternating-current generators, 125 cycles; artificial lights for mills; electric railway locomotives and sockets, receptacles and fixtures for 500-volt circuits.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces that it can make immediate shipment of alternating current desk and ceiling fans for regular voltages and alternations. The company can ship special windings for special voltages and alternations in one week.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—The ninth annual meeting of the American Electro-Therapeutic Association will be held at Washington, D. C., on Sept. 19, 20 and 21 next. There will be a large and varied exhibition of electro-therapeutic apparatus in Willard's Hall during the meeting.

THE GENERAL INCANDESCENT LAMP COMPANY has been organized in Cleveland, Ohio, to manufacture and deal in electrical machinery and electric lamps. The capital stock is $50,000 and the names of the incorporators are J. Insull, F. H. Goff, T. H. Bushnell, S. H. Tolles and J. McGregor, Jr., all of Cleveland.

THE RARITAN ELECTRIC MANUFACTURING COMPANY.—It is said to be the intention of the Raritan Electric Manufacturing Company of New Brunswick, N. J., to rebuild its factory, which was destroyed by fire on the night of July 4. Improved machinery will be installed. The name of this company's lamp will be "Surpass."

THE MASON TELEPHONE PAY STATION COMPANY is making a special feature of telephone booths. It has a factory especially equipped for this class of work, and can take care of a large business. Its catalogue No. 3 contains descriptions of its regular line of booths, in addition to which it makes any special design required.

MR. GUION THOMPSON has opened an office as consulting electrical engineer at 289 Fourth Avenue, New York. Mr. Thompson has had a very extensive experience in electric light and power station work, and he will give special attention to the applications of electricity in private houses, the theatrical stage, and to automobile and electro-medical work.

THE MORRIS ELECTRIC COMPANY has been organized, with headquarters in Jersey City, N. J., to manufacture electric apparatus and devices. The capital stock is $125,000. The company was incorporated by the following named gentlemen: Elmer P. Morris, Jersey City; William G. Hubbard, Jr., Asbury Park, and H. F. Sanville, New York City.

THE DIAMOND METER COMPANY, Peoria, Ill., has just brought out a pamphlet on its Scheefler recording wattmeters. It is stated that these meters

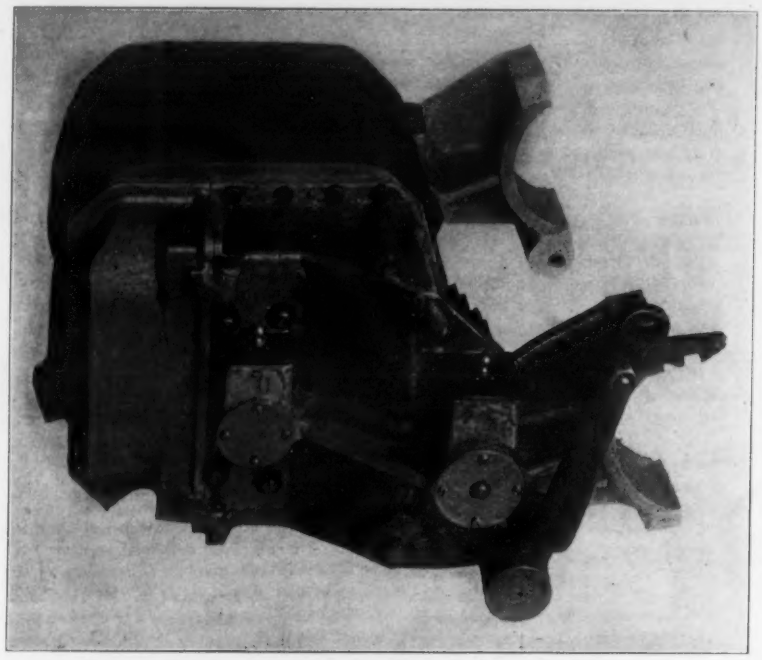


FIG. 8.

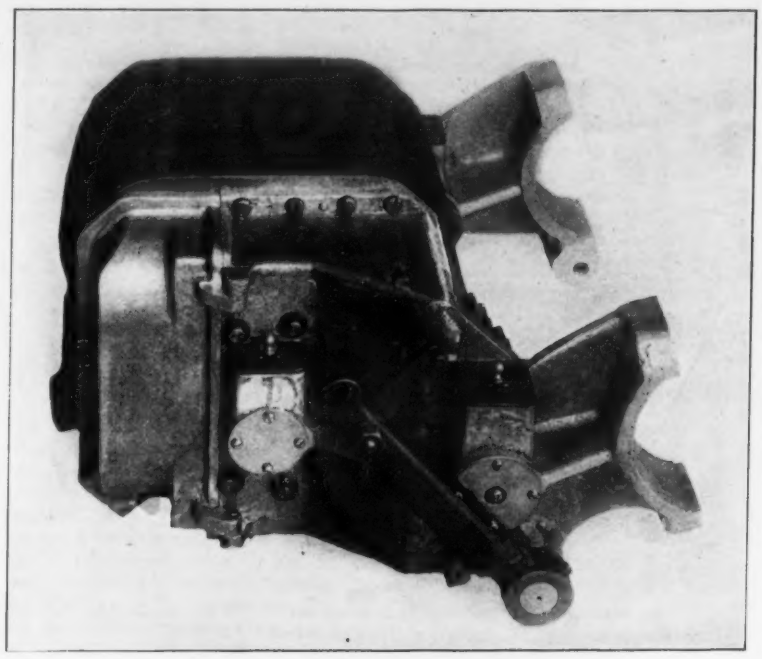


FIG. 7.

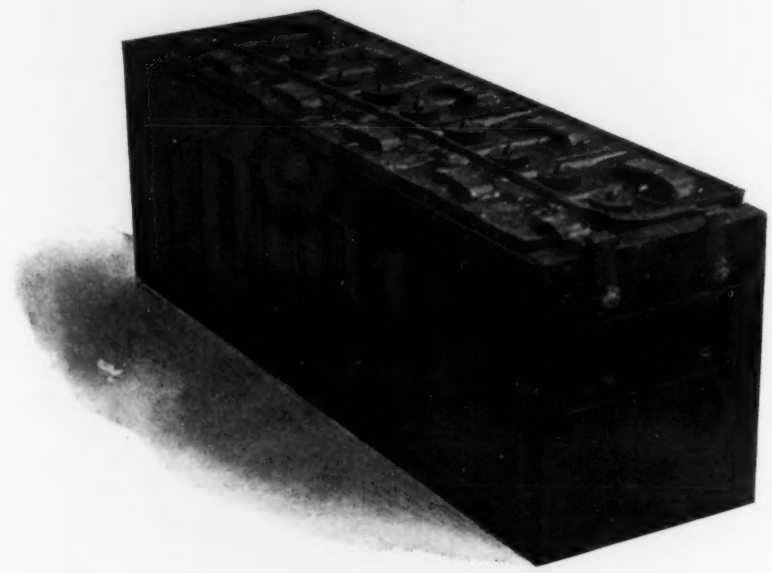


FIG. 13.

AMERICAN

TYPES OF AUTOMOBILES—III.

Sperry Electric Carriages

SHOWING MOTOR, BATTERY, CONTROLLER, STEERING GEAR, ETC. FIGS. 1 TO 13.

See Page 127.

FIG. 11.

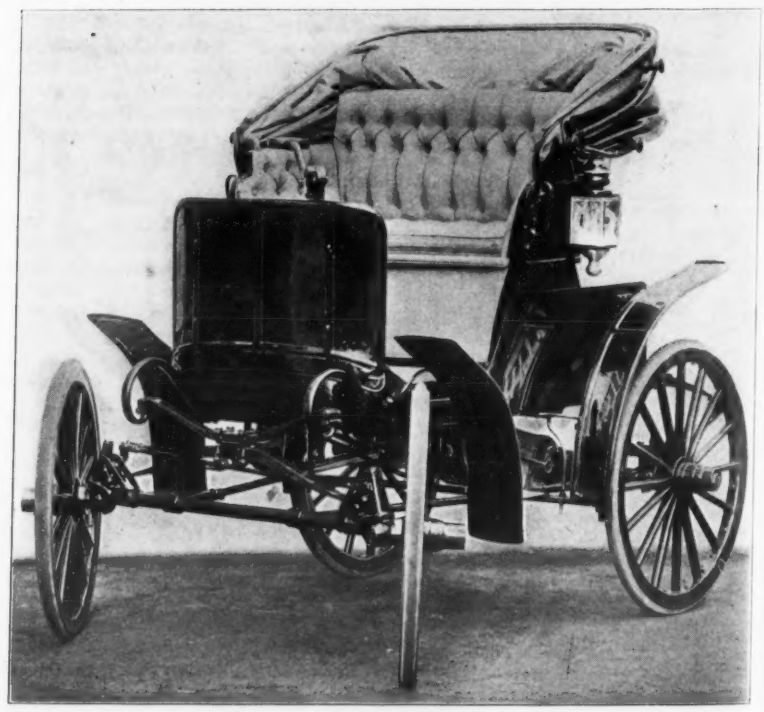


FIG. 6.

FIG. 1.

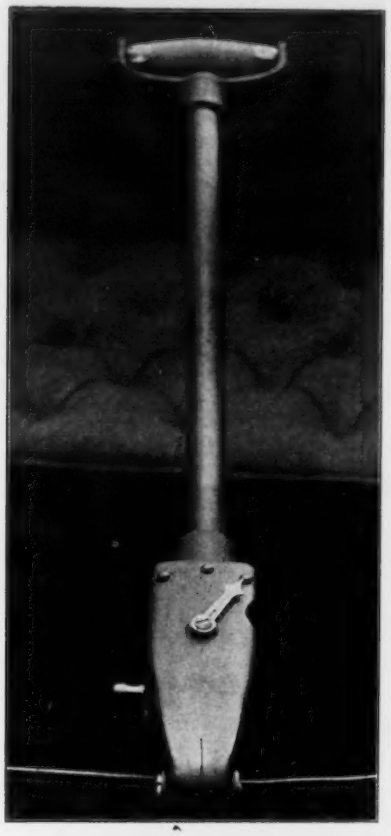


FIG. 9.

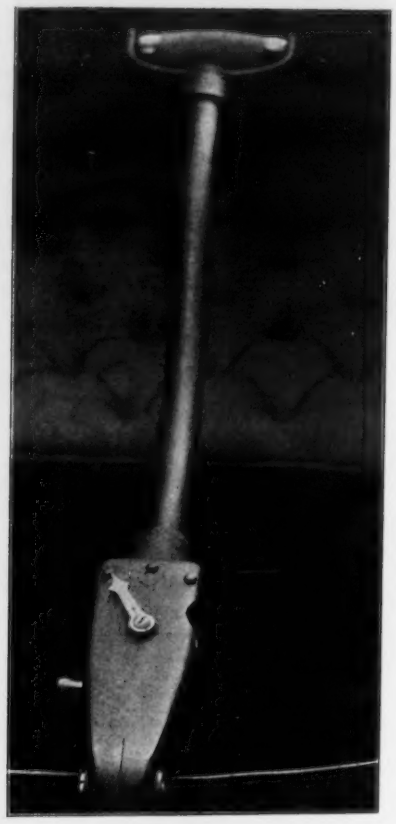


FIG. 10.

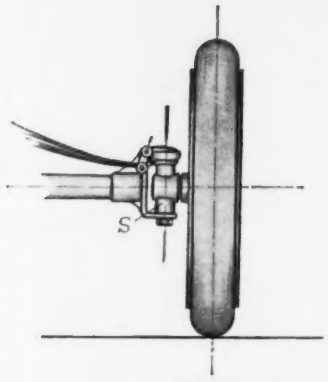


FIG. 4.

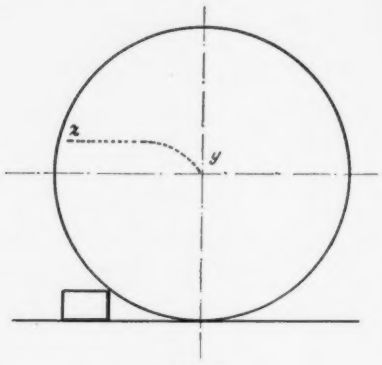


FIG. 5.

FIG. 3.

FIG. 2.

FIG. 12.

are accurate at all loads, dustproof, correct on indication and highly sensitive. The pamphlet gives a complete description of the meter, which instrument is illustrated in detail. At the back is given a telegraph code for the purpose of facilitating orders by telegraph.

MESSRS. MOREHOUSE & MORRILL, a firm of mechanical and electrical engineers at Quezaltenango, Guatemala, are operating various electrical enterprises in that country, including the electric lighting company of Quezaltenango, the Western Telephone Company and the Coast Telephone Company. Reference was recently made to this firm in these columns as being located in Quezaltenango, Mexico. The town is in Guatemala, not Mexico.

MR. WILLIAM M. SHEEHAN, formerly of the firm of Sheehan & Hewitt, electrical engineers and contractors, Newburg, N. Y., announces that he will continue in the same business, and has taken offices in the Highland Bank Building, 22 Water street, where he will be pleased to make estimates, etc., and to cater to the wants of his former patrons and the public generally. He is engaged in prosecuting a number of contracts now on hand. The firm of Sheehan & Hewitt was recently dissolved, as announced in these columns last week.

TELEPHONE PROTECTIVE DEVICES.—A matter of the very greatest importance to telephone exchanges is the protection of their apparatus from burn-outs from lightning and other heavy currents. The device handled by the Electric Appliance Company, of 92 and 94 West Van Buren Street, Chicago, is claimed to have a number of very excellent points. The company states that it has sold large quantities of these and that the results have been most satisfactory.

THE PACIFIC INCANDESCENT LAMP COMPANY, 933 Market Street. San Francisco, Cal., is giving its entire attention to the manufacture of incandescent lamps, and the refilling of burned-out lamps. This is a new enterprise on the Pacific coast, and the company reports that it is meeting with good success. This company heretofore conducted a construction business under the name of the Pacific Coast Electric Company. Mr. Samuel Marx is the business manager.

U. S. METAL POLISH is becoming a great favorite for keeping the bright work of electrical machinery clean. George William Hoffman, of Indianapolis, the maker, reports that he is gaining new customers in the electrical field every day. This polish has been on the market for many years and has always been a good seller. From present prospects Mr. Hoffman believes the sales this year will break all previous records. He is willing to send a free sample to anyone who wishes to give it a trial.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., has just opened a branch office in San Francisco to better take care of its largely increasing Pacific coast trade. The Paul Seiler Electrical Works will still act as agents, but the Columbia Company will have an office in charge of Mr. Alexander R. Pike. The address of the office will be 120 Sutter Street. A large and well assorted stock of lamps will be maintained and the company expects to be able to handle the coast business more satisfactorily than ever.

THE DYNAMO BRUSH HOLDER IMPROVEMENT COMPANY, Philadelphia, Pa., is manufacturing the Yearsley improved brush holder for dynamos and motors. This device holds the brush closely and with uniform pressure upon the surface of the commutator, thus preventing sparking and overheating, at the same time increasing the life of the commutator and the efficiency of the machine. It is the invention of Mr. James H. Yearsley, the engineer in charge of the electric plant of the estate of Walter L. C. Biddle, Philadelphia.

BOILER PRICES ADVANCED.—Manufacturers of boilers and engines have notified their agents that prices must be advanced about 5 per cent. at once. Since last January the engine and boilermakers have advanced prices 30 per cent. W. J. Carlin, Pittsburg, said that some of the boilermakers expect that pig iron, now at $20 a ton, will advance to $30 before the year expires. He said that in January boiler plate could be had for 95 cents per 100 pounds, but that now it was hard to get it at $2.05 per 100 pounds. The rise in price will affect operations in the oil fields, where many boilers are used.

THE UNITED STATES ELECTRIC SIGNAL COMPANY, which was recently organized under the Maine laws, will probably establish its factory at Newton Highlands, Mass. The company was organized for the purpose of manufacturing electrical signals and other electric devices, chiefly for street railways. The signals will be made under patents granted to John J. Ruddick, Charles E. Rand and others and are the property of the company. The officers of the company are: Prof. Charles H. Morse, president; Dr. Frederick E. Withee, secretary; James H. Nickerson, treasurer; Frederick V. Chase, clerk.

HANDSOME RAILWAY LITERATURE.—Very artistic in appearance and full of information to the prospective tourist are the new publications issued by the Grand Trunk Railway system, descriptive of the "Highlands of Ontario" and other resorts in Canadian territory reached by its lines. No finer scenery in the world can be enjoyed or a more health-giving region visited than the renowned Muskoka Lakes district, within a few hours' ride of Buffalo, and only 112 miles north of Toronto. W. E. Davis, general passenger and ticket agent, Grand Trunk railway system, Montreal, will send copies of literature free.

FAN VENTILATION.—One of the greatest obstacles in the way of positively ventilating small apartments has been the difficulty of operating the fan introduced for the purpose. The B. F. Sturtevant Company, of Boston, has made a careful study of this problem, has reduced the apparatus to the simplest form, and presents in its Bulletin M. illustrations and descriptions of its electrically driven propeller fans. The motor is directly attached to the fan shaft. The fan is of the most efficient type, and the entire arrangement is readily portable. It may be instantly started and stopped by the mere operation of a switch.

SPANISH-AMERICAN WAR PANORAMA AND GREATER AMERICA is one of the war books which is likely to be in continuous demand. It is a panoramic record of the triumph of Yankee Doodle. The eagle flaps his wings on every page, and "Old Glory" waves around and above every scene. Prominent officers connected with the war are here portrayed, as well as many of the "men behind the guns." The album is 5½x8 inches, weighs 12 ounces, printed on finest coated paper. Mr. Warren J. Lynch, general passenger and ticket agent "Big Four Route," Cincinnati, O., will mail a copy to any address in the United States, Canada or Mexico, for 12 cents to cover postage and packing.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has issued a very handsome catalogue descriptive of the various machines manufactured by it. These include belted generators, engine type generators and electric motors of various sizes and types. There are a great many illustrations in the catalogue showing the different types of machines and many construction details. The illustrations are artistic in execution and include views of actual applications of motors and generators. A special feature is the use of these motors in driving printing presses, machine tools, etc. The catalogue shows that a very extensive variety of machines are turned out from this company's shops.

THE MILWAUKEE ELECTRIC COMPANY, 296 Reed Street, Milwaukee, Wis., which was recently incorporated, will manufacture and sell electrical machinery and appliances. The officers of the company are: President, William P. Harper; vice-president, Walter Cary; secretary and engineer, H. W. Morris; treasurer, John A. Whaling. All of these gentlemen were former officers and employees of the Gibbs Electric Company, of Milwaukee, and their reputation for engineering and business ability makes a good foundation for the success of the new enterprise. The company will furnish estimates on electrical apparatus for lighting, power for driving machinery and manufacturing plants. Its repair shop is equipped to do the best work.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., reports that the sales of its Adams-Bagnall inclosed direct and alternating current arc lamps have been unprecedented. The public has been quick to recognize the many good points and improvements which have been made in this lamp. In nearly every case where they have had competitive tests, the Adams-Bagnall lamp has shown itself to be far superior in every way to all others. The Allegheny County Light Company, Pittsburg, Pa., after a series of exhaustive tests of all of the most prominent lamps on the market, placed its order for 1400 Adams-Bagnall inclosed arcs to be used throughout its system. This is one of the largest orders placed lately, and speaks volumes for the lamp.

MESSRS. MORRIS E. LEEDS & CO. have purchased the plant, drawings, fixtures, etc., of Messrs. Elmer G. Willyoung & Co., and will continue the business at the old address, 939 Boyer Street, Philadelphia. Mr. Leeds is personally well qualified to conduct the business of manufacturing scientific instruments since he has been engaged in this line for the last ten years. In 1892 he made a special study of European methods of manufacturing scientific apparatus. After returning to Philadelphia he became manager of the electrical and physical department of Messrs. Queen & Co., Incorporated, which position he resigned in May last to go with Willyoung & Co. Mr. James G. Biddle, of Philadelphia, who acted as sole agent for Messrs. Willyoung & Co., will act in the same capacity for Messrs. Leeds & Co.

IDEAL ENGINES.—Messrs. A. L. Ide & Sons, Springfield, Ill., have just issued a very handsome catalogue of their Ideal automatic cut-off steam engines. The various types of engines are illustrated with cuts of high artistic finish, and various sectional and perspective views show the most important details of the engines. The Ideal throttle valve, the Ideal steam separator, the Ideal reducing motion, the Ideal power transmitter, and the Ideal belt tightener are also listed and illustrated. The details of construction of the engine are very thoroughly described. The make-up of the catalogue is extremely attractive. The cover, which is of emerald green, has the style of the firm and a representation of an Ideal engine embossed upon it in gold. The pages are printed in two colors—the text in green and the illustrations in black.

MR. F. C. SUTTER, of the Pittsburg Transformer Company, Pittsburg, Pa., visited New York July 10 to 12, his special mission being to obtain an agency for his company's apparatus in New York and New England. Mr. Sutter was fortunate in obtaining the Western Electric Company, who will hereafter handle the Pittsburg "type K" transformer in these districts. Mr. Sutter stated that the Pittsburg Transformer Company has found no summer season this year in its business, its orders increasing regularly month after month. The company has been obliged to put in new machinery as fast as possible to handle the growing trade. One large source of business is the active work of the Rumsey Electrical Manufacturers' Company, which is making exceptionally large sales in Philadelphia and adjoining territory, considering the fact that it is the summer season.

COCHRANE HEATERS AND SEPARATORS.—The Harrison Safety Boiler Works, Philadelphia, Pa., have just issued a very interesting pamphlet on the subject of Cochrane heaters and Cochrane separators. It points out in a very telling manner the reasons why heaters and separators should be used in connection with steam plants and the argument is presented in a manner as convincing to the eye, by means of illustrations, as to the reason, through the medium of words. The features of these heaters and separators, and the advantages to be derived from their use, are made plain and convincing. Every steam plant manager and engineer should secure a copy. The Harrison Works state in the pamphlet that they are in business to make money by saving it for others. The pamphlet tells how money can be saved. It is gotten up in a very attractive manner, and is unique in the method employed in presenting the facts.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has just issued its catalogue No. 996, of sixteen pages, devoted exclusively to Carpenter enamel rheostats. This catalogue of field rheostats is remarkably comprehensive, containing detailed and exact information regarding 125 different standard forms of field rheostats, all of which are customarily carried in stock by the Ward Leonard Company. The list is so comprehensive and explicit that a rheostat can be selected from it which will be adapted to almost any possible use on any commercial circuit, for while the rheostats are designed for use as field rheostats the complete data given as to number of steps, ohms, ampere capacity, size, etc., enables one to pick out a rheostat suitable for use in connection with ventilating fans, organ blowers, centrifugal pumps, storage batteries and all such special applications of continuous duty rheostats. Each one of the 125 standard rheostats has its own code word, which makes the catalogue very convenient for foreign customers.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JULY 11, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

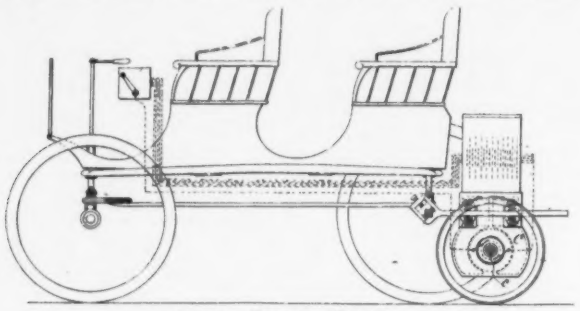
628,457. DEVICE FOR PRODUCING ELECTRIC CURRENTS AT SEA BY THE ACTION OF WAVES; M. Gehre, Rath, Germany. App. filed April 6, 1899. The apparatus consists of rods projecting out of the sea to a suitable extent, one of which carries at its upper end an induction coil and another a magnet with alternating poles, while between the rods a connection is established in such a way that a rising and falling of one rod is produced by the action of the waves by means of a float and thereby a displacement of the induction coil with respect to the magnet, is brought about, and a current produced which may be used for flash lights or other purposes.

628,464. ELECTRIC SIGNALING APPARATUS AND CIRCUIT; F. B. Herzog, New York, N. Y. App. filed Oct. 25, 1884. The main feature of this invention consists in providing a substation, such as a guest chamber at a hotel, with an instrument by which the guest can signal to the hotel clerk his various wants, and in so combining and connecting these separate instruments with means for releasing them and receiving the signals controlled by the clerk that, if desired, the mere act of setting any guest's instrument automatically operates an annunciator at the receiving end to inform the clerk that the particular instrument has been set, and that thereupon the clerk when he is ready can by making circuit connections introduce a receiving instrument, release the guest's signal instrument and thus receive the guest's signal at once.

628,492. SECONDARY BATTERY; C. Risdale, Chicago, Ill. App. filed May 28, 1897. The plate comprises in its construction a sheet of oxide of lead formed in a complete integral mass having extensions in the form of ridges along its side and corresponding recesses between the ridges; a strip of conducting material extends centrally through the plate. (See Current News and Notes.)

628,514. ELECTRIC VEHICLE; W. F. Zimmerman, East Orange, N. J. App. filed May 12, 1899. This is a detachable electric propelling device comprising an electric motor, a source of current, an axle and its traction wheels, which is adapted to be transferred from one vehicle to another, as occasion may require.

628,539. TROLLEY WHEEL; J. Kalte, Port Elgin, Canada. App. filed March 11, 1899. The trolley wheel is provided in the center with a double tapered



628,514.—Electric Vehicle.

cup, which is fitted into a corresponding axle hole, cones being provided at each side to hold the balls and complete the bearing.

628,567. TELEPHONE SWITCH APPARATUS AND CIRCUIT; T. C. Wales, Jr., Newton, Mass. App. filed April 17, 1899. In the operations of connecting and disconnecting a through circuit, consisting of a substation circuit, a relay switchboard, a trunk circuit, and a long distance or toll circuit, an important part consists in the automatic operation of signals whereby information is given to the several operators at the different terminals of the circuits as to connections desired and connections made, and also of the necessity of making disconnections. The features of this invention are that when the through circuit is made up the supervisory signal before the operator at the long distance office, is controlled by the telephone hook switch at the substation, and also that when the operator at the long distance office takes down the connection, a disconnecting signal will be shown before the trunk line operator at the relay switchboard.

628,597. ELECTRIC ELEVATOR ALARM; H. R. Bruhns, San Francisco, Cal. App. filed Dec. 30, 1898. A device consisting of a push button which is operated by the elevator car to sound an alarm upon the approach of the elevator to a landing.

628,610. TROLLEY POLE; S. G. Reynolds, Easton, Pa. App. filed Jan. 7, 1899. There are three wheels mounted in the harp and arranged at right angles to each other, the principal object being to prevent the trolley from jumping the wire.

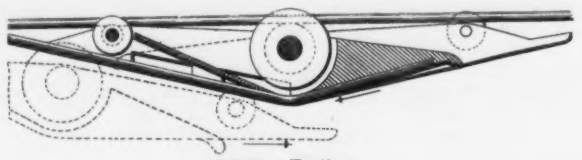
628,658. ELECTRIC LIGHTING APPARATUS FOR RAILWAY CARS; C. A. Gould, New York, N. Y. App. filed July 7, 1898. The dynamo is mounted on the car on springs in such a manner that it remains at all times practically in the same relative position to the car axle notwithstanding the vibrations of the car, thereby keeping a uniform tension on the belt which is used to drive the dynamo from the axle.

628,659. ELECTRIC LIGHTING SYSTEM FOR CARS; J. C. Crevelin, New York, N. Y. App. filed Jan. 31, 1899. The principal features of the invention lie in a pole changing and a cut-out switch for controlling a generator driven from the axle of the car. In case the car changes its direction of travel the pole changing switch is operated, and in case the limit of speed is reached the other switch is operated.

628,661. BATTERY ELECTRODE; J. C. Howell, London, England. App. filed July 8, 1898. The electrode consists of a metallic ribbon in the form of a helix, with each turn in the form of a cone, and partially covering the next preceding turn, the object being to increase surface. (See Current News and Notes.)

628,662. TROLLEY; H. J. Humphrey, Philadelphia, Pa. App. filed May 27, 1896. The trolley is so constructed that it can pass another on the same wire. The wheel is mounted in a cage having inclined approaches over which another trolley can roll.

628,667. INSULATED RAIL SUPPORT; C. K. King and G. A. Mead, Mansfield, Ohio. App. filed May 24, 1899. The insulator is covered by a metallic cap held in such a way thereon that it cannot turn, the cap having suitable clamps in which the rail is seated.



628,662.—Trolley.

628,676. FORMING ACCUMULATORS; C. Pollack, Frankfort-on-the-Main, Germany. App. filed March 14, 1897. A lead electrode is first treated as an anode with a current which does not exceed two volts, thereby producing a covering of lower oxide of lead, and then completing the formation by the use of a current of higher electromotive force. (See Current News and Notes.)

628,685. THEATRE DIMMER; W. Beresford, Westfield, N. J. App. filed Feb. 27, 1899. The resistance plates are mounted independently of each other so as to be removable from the frame, the object being to avoid the necessity of taking the whole apparatus apart when it is desired to remove one or more of the plates.

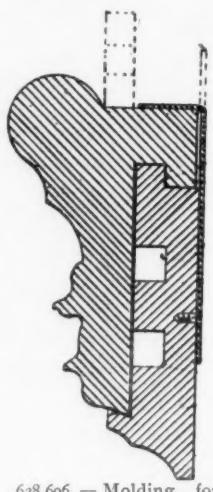
628,695. ELECTRICAL COOKING APPARATUS; J. B. Cary, Baltimore, Md. App. filed March 10, 1899. The heating devices are ordinary incandescent lamps placed within a chamber of such construction that most of the heat is concentrated beneath the cooking utensils.

628,696. MOLDING FOR ELECTRIC WIRES; M. and M. F. Chase, Boston, Mass. App. filed Oct. 17, 1898. The molding is made in two parts, one of which contains grooves for the wires, while the other is facing to cover the grooves and is held in place by interlocking flanges.

628,702. ELECTRICAL HOT AIR HEATER; J. J. Elliott, Butte, Mont. App. filed Jan. 10, 1898. A large drum containing an electrical heating device and passages and chambers through which the air circulates.

628,739. PRIMARY BATTERY; E. Baines, New York. App. filed Dec. 25, 1897. The crystals of copper sulphate are placed upon a horizontal non-metallic grid inserted between the two electrodes, the object being to have the electrodes in clear solution.

11,759. INSULATION OF ELECTRIC WIRES; J. A. Poche, New Orleans, La. App. filed April 10, 1899. To insulate a prime conductor on an influence machine, it is surrounded by an insulating sleeve and two enclosing glass cones.



628,696.—Molding for Electric Wires or Other Purposes.

628,762. AUTOMATIC CIRCUIT BREAKER; C. M. Clark, New York. App. filed Jan. 23, 1899. The main feature of the device is a disk of insulating material which tends to rotate under the action of a spring, its locking device being tripped by the controlling magnet.

628,770. MANUFACTURE OF ELECTRIC CONDUCTORS; Sherrard Osborn Cowper-Coles, of London, England. App. filed Dec. 24, 1897. (See Current News and Notes.)

628,807. ELECTRIC TRANSFORMER; S. K. Humphrey, Boston, Mass. App. filed Oct. 1, 1898. A transformer, comprising a core consisting of a disk having a series of openings through it, a multiplicity of primaries rove through said openings and over the periphery of the disk, the said primaries being arranged in a plurality of sets placed opposite each other and connected one set with the opposite set; a continuous secondary winding consisting of a series of coils, each having connection with segments of a stationary commutator, and auxiliary windings extended across the centre of the disk and connected in parallel with the primaries. (See Current News and Notes.)

628,849. ELECTRIC CURRENT REGULATOR; F. E. Ramsey, Walkinburg, Colo. App. filed Oct. 14, 1898. The regulator is designed particularly for incandescent lamps. Its resistance circuit is made up of an annular coil wound radially in layers, each layer is in connection with a contact plate, the series of plates adapted to be engaged by a movable contact arm.

628,855. GALVANIC BATTERY; W. Rowbotham, Birmingham, England. App. filed Oct. 21, 1895. A vessel is divided by non-porous perforated partitions into inner and outer chambers. The inner chambers contain the elements of the battery, while the outer chambers serve as reservoirs for supplying fresh solution to the inner chambers.

AUTOMATIC TIME SWITCH.

It Starts AND It Stops.

ALTERNATING OR DIRECT CURRENT.

Also the best ARC CUT-OUT.

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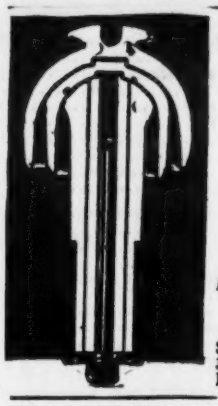

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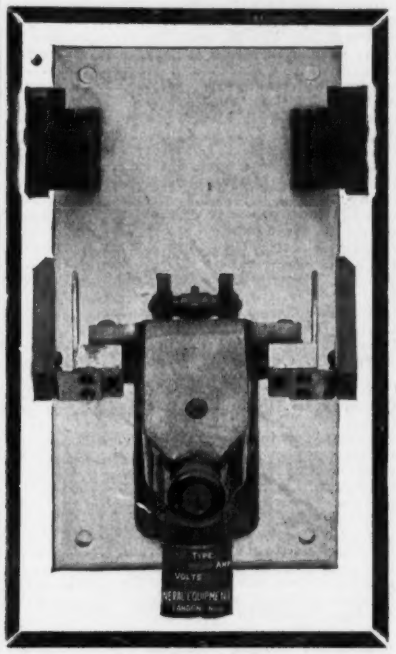

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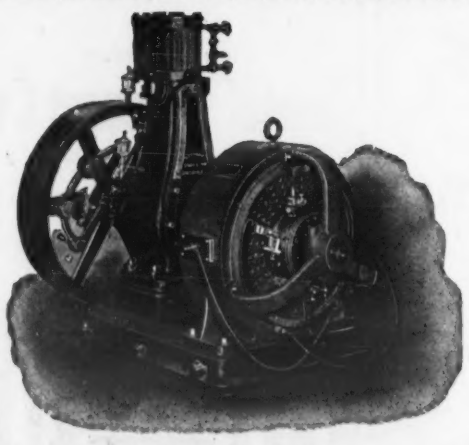

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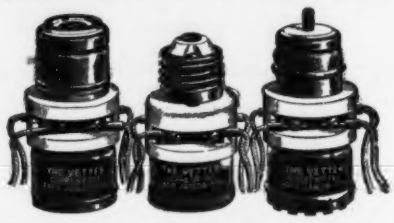

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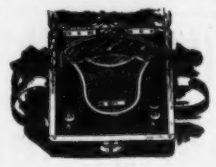

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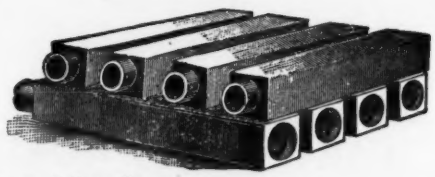

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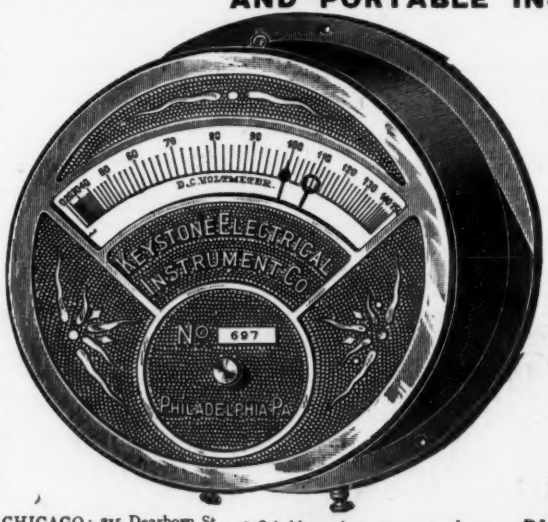

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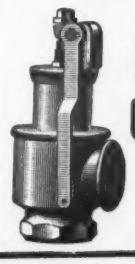

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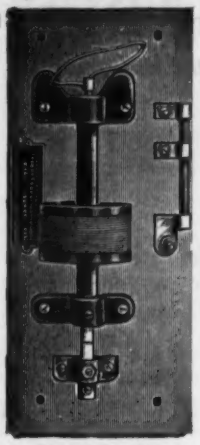

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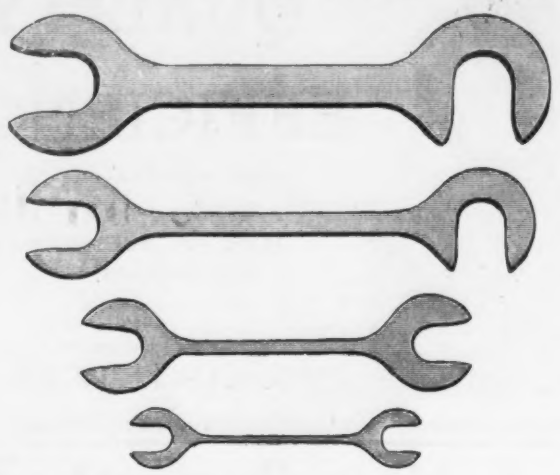

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